THE
UNIV. OF MICHIG
DEC 21 1951
EAST ENGINEERING
LIBRARY

an international monthly

Petroleum Engineer

ombined Edition

Drilling and Producing | Refining and Gas Processing | Oil and Gas Pipelining

MUD LINE VALVES
INTERNALLY ARMORED
WITH HARD FACING

ERCHROME COATED
UG & BODY HARD FACED
RECISION GROUND & LAPPED
GHEST EROSION RESISTANCE
ON-GALLING — NON-SCORING
W COEFFICIENT OF FRICTION
REATLY INCREASED VALVE LIFE
AILABLE WORKING
ESSURE TO 10,000 LBS

Nordstrom MUD LINE VALVES

Tremendously increased life is added to Nordstrom mud line valves by application of Merchrome coating. Valves removed for inspection after drilling several wells reveal little or no abrasion. The exclusive Nordstrom Merchrome coating process provides the hardest of hard-facing on the plug and interior of the body. It attains the closest approach to indestructibility. For greatest economy and longest life, install Nordstrom on all drilling lines.

Ask for Literature

ROCKWELL MANUFACTURING COMPANY
400 N. Lexington Ave., Pittsburgh 8, Pa. Offices in principal cities

e of Contents Page 3 • Advertisers' Index Page 6
NEW MACHINERY AND SUPPLIES E-51

DECEMBER 1951

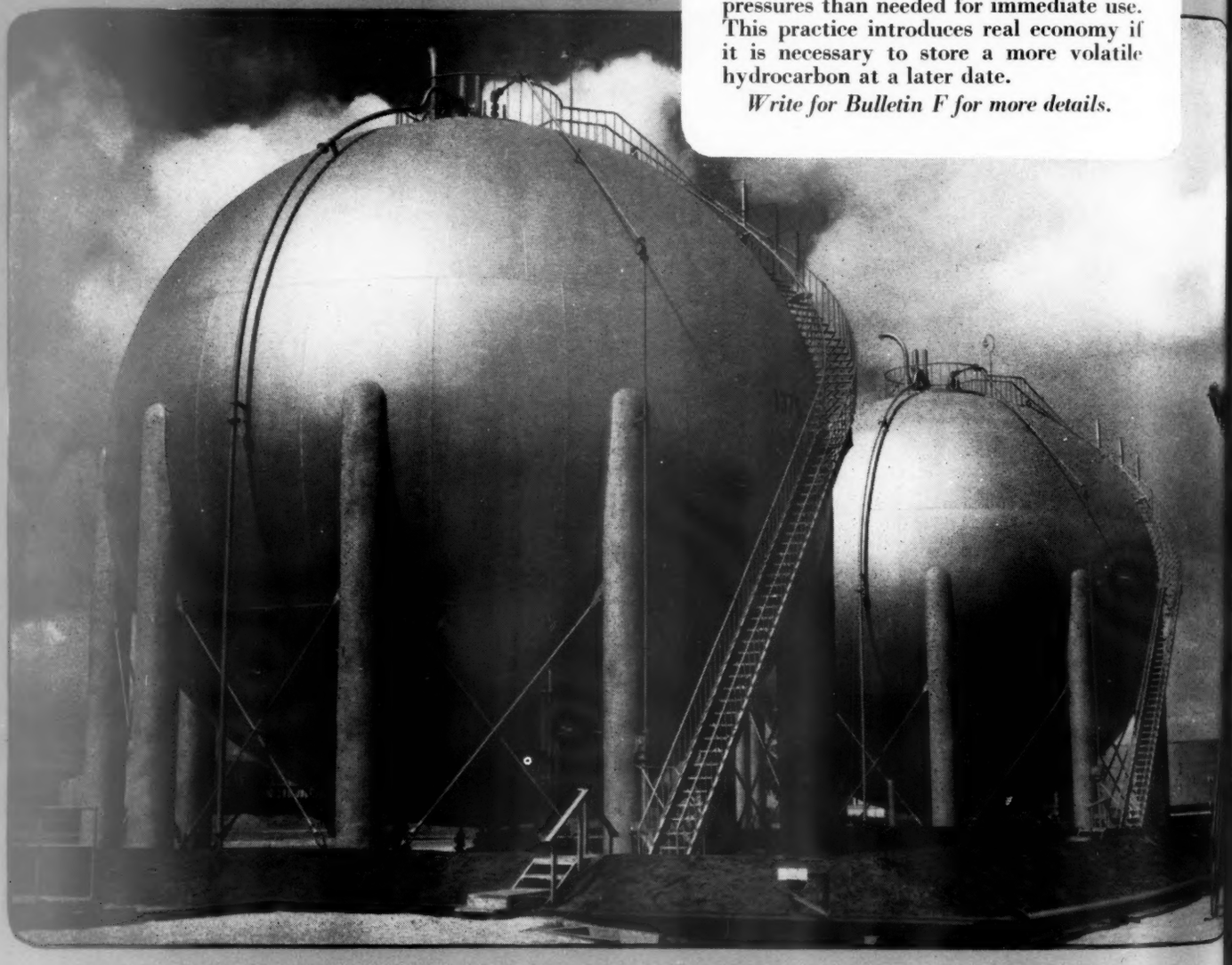
HORTONSPHERES

don't let volatile hydrocarbons escape

There's practically no loss of the refined product when you select Hortonspheres for the storage of butane and other volatile hydrocarbons. These efficient containers are designed to resist internal pressures resulting from high volatility or pressure variations caused by daily temperature change. None of the contents escape through the vents as long as the internal pressure does not exceed the relief valve setting.

Some operators like to install Hortonspheres designed to withstand higher pressures than needed for immediate use. This practice introduces real economy if it is necessary to store a more volatile hydrocarbon at a later date.

Write for Bulletin F for more details.



CHICAGO BRIDGE & IRON COMPANY

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY, and GREENVILLE, PENNSYLVANIA

Atlanta 3.....2174 Healey Bldg.
Birmingham 1.....1870 North Fiftieth St.
Boston 10.....1028—201 Devonshire St.
Chicago 4.....2481 McCormick Bldg.
Cleveland 15.....2251 Guildhall Bldg.
Detroit 26.....1538 Lafayette Bldg.
Houston 2.....2137 National Standard Bldg.
Los Angeles 17....1546 General Petroleum Bldg.
New York 6.....3373—165 Broadway Bldg.
Philadelphia 3..1638—1700 Walnut Street Bldg.
Salt Lake City 4.....829 West 17th South St.
San Francisco 4.....1864—200 Bush St.
Seattle 1.....1329 Henry Bldg.
Tulsa 3.....1634 Hunt Bldg.
Washington 6.....1136 Cafritz Bldg.

REPRESENTATIVES AND LICENSEES:

Horton Steel Works, Limited, Fort Erie, Ontario, Canada
Ateliers et Chantiers de la Seine Maritime, Paris, France
Constructions Metalliques de Provence, Arles-sur-Rhone, France
Chicago Bridge & Iron Company, Ltd., Apartado 1348, Caracas, Venezuela
Compagnia Tecnica Industrie Petroli, Rome, Italy
Whessoe, Limited, Darlington, England
Motherwell Bridge & Engineering Company, Limited, Motherwell, Scotland
Comprimo N. V., Amsterdam—O, Netherlands
Sociedade Chibridge de Construcoes Ltda., Av. Franklin Roosevelt, 194-S/704-C, Rio de Janeiro, Brazil

THE Petroleum Engineer

COMBINED EDITION

• Drilling and Producing • Refining and Gas Processing • Oil and Gas Pipelining

DECEMBER, 1951 • VOLUME XXIII • NUMBER 13

GENERAL

Freedom's Oil A-33
Lt.-General Ernest O. Thompson

The Importance of Technology in Developing Oil Production A-37
C. E. Reistle, Jr.

The Oil Problem in the Middle East A-50
George C. McGhee

Features

Course of Oil A-4
With the Editors A-8
Highlights in Oildom A-10
Petrolic Personalities A-12
Dick Sneddon
Meetings A-15
Letters to the Editors A-18
Petroleum Profile A-52
William Laughlin McLaine
News E-2
Personals E-8
The Petroleum Engineer's Continuous Tables E-13
(Installment No. 173)
Laugh With Barney E-30
Oil and Gas Trade News E-32
Trade Personals E-40
New Machinery and Supplies E-53
Trade Literature E-57
Books E-60

DRILLING AND PRODUCING

Good Mud Control Saves Pipe B-7
H. I. Bussa, F. B. Vick

A New Kentucky Oil Pool B-11
Willard Rouse Jillson

Crooked Holes B-16
Bruno Schabarum

Graphical Method of Evaluating Performance of Oil Well Sucker Rods B-30
J. P. Pedretti

Training Men for Drilling Fluid Work B-36
W. R. Mays

Slush Pump History and Possible Developments B-40
Roy E. Edwards

Pulsation Snubbers B-50
J. R. Bailey

How to Mount Posts on Rig Floor B-52

Workovers in West Texas B-55
T. W. Kidd

New Welded Full View Mast B-62
J. B. McCormick

Evaluation of Rotary Drilling Lines B-73
J. U. Teague

Status of Russian Petroleum Industry B-79

Features

Presenting B-3
News B-80
What's Doing in Drilling B-86
Exploration Activities B-90
Running Tour With Men in the Industry B-94

REFINING AND GAS PROCESSING

LPG—Oil's Fourth Dimension C-3
Arch L. Foster

Ultra Modern Canadian Lubricant Plant C-5
Harry Chapin Plummer

Pilot Plant Design C-11
B. M. Wedner, W. A. Horne, T. P. Joyce

60 Per Cent More Refining Capacity C-17
Arch L. Foster

Accounting to Producers for Residue Gas C-24
Ralph A. Worley

Gas Plants for Catalytic Cracking Units C-26
Forrest E. Gilmore and Robert D. Bauer

The Technical Forum C-38
Removal of Boiler Scale

Features

News C-40
Refining and Gas Processing Personals C-50

OIL AND GAS PIPELINING

Blending and Heat Solve Heavy Oil Problem D-3
William T. Rintoul

Computing Gas Pipe Lines D-7
J. F. Voorwijk

Developments in Products Pipe Line Technology D-11
J. R. Shipley

Application of Pipe Line Control Equipment to Field Operations D-18
H. T. Chilton, Jr.

Cold Weather Pipelining D-28
T. S. Johnston

Steam Turbo-Compressor Stations D-35
Part 2
H. L. Norris, Jr.

Features

News D-43
Pipe Line Personals D-54
Pipe Line Projects D-56
With the Pipe Line Contractors D-60

The PETROLEUM ENGINEER Publishing Company, Irwin-Keasler Building, DALLAS 1, TEXAS. W. L. LOVE, *President;* W. T. BRYAN, *General Manager and Treasurer.* **Editorial Staff**—K. C. SCLATER, *Vice President and Editor-in-Chief;* ERNESTINE ADAMS, *Managing Editor;* ARCH L. FOSTER, *Editor, Refining and Gas Processing;* FRANK H. LOVE, *Editor, Oil and Gas Pipelining;* MARY MORRIS, *Editorial Assistant;* RICHARD SNEDDON, *Editor, Pacific Coast,* 1106 B North Louise Street, Glendale 7, California. Phone, Chapman 5-1951. **Advertising Staff**—T. J. CROWLEY, *Vice President and Advertising Manager;* New York—JOE B. WOODS, 52 Vanderbilt Avenue, New York 17, New York. Phone MUrray Hill 4-1880; Chicago—E. V. PERKINS, 53 West Jackson Blvd., Chicago 4, Illinois, Phone, HArrison 7-6883; Los Angeles—RICHARD P. McKEY, Bendix Bldg., 1206 South Maple, Los Angeles 15, California. Phone, PRospect 3919. **Promotion**—ABBOTT SPARKS, *Manager;* ROYAL COURTNEY, *Assistant Circulation Manager.*
Indexed by *Industrial Arts Index and The Engineering Index, Inc.*

Copyright 1951 by The Petroleum Engineer Publishing Company.
Member of Audit Bureau of Circulation and Associated Business Papers.

the Course of OIL

THE YEAR AHEAD

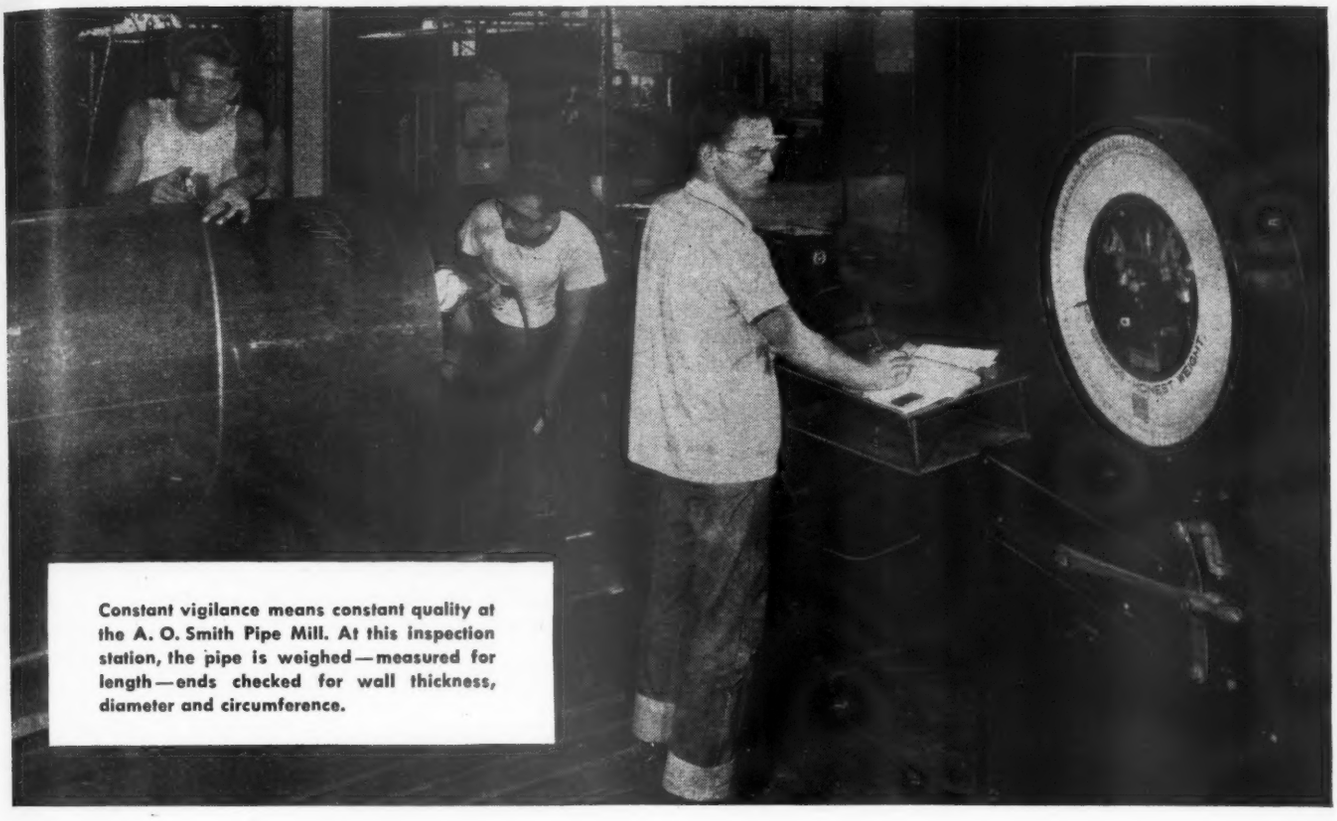
All indications point to a heavy domestic demand for petroleum in 1952. Consider the figures for 1951. They will probably show a daily average domestic demand in excess of 7 billion barrels; the average daily domestic production, however, will probably be about 400,000 barrels below this figure. For 1952 it is estimated that the domestic demand will be between 6 and 7 per cent greater than in 1951. It appears that a substantial increase in producing capacity and in the discovery of new domestic oil reserves will be necessary in the coming year. What are the prospects for accomplishing this? Looking back, "Our record of finding and producing oil while building up our known reserves is an excellent one. From the time that commercial oil was first discovered in the United States until the end of 1950 we have found more than 66 billion barrels, produced almost 41 billion, and had a crude reserve of 25.3 billion. This, with a reserve of 4.2 billion of natural-gas liquids, gives us a total known proved reserve of liquid hydrocarbons, as of the end of 1950, of 29.5 billion barrels."

Based on past performance, prospects are good for the discovery of new oil reserves in North America. Consider the record of the last 10 years. Of 34 petroleum provinces reported by the American Association of Petroleum Geologists in 1941 "not one has been condemned as unproductive, and important fields have been found in 18 of the 34. During the decade covered by these geological studies 308,000 wells were drilled. Not only is the surface area of possible future oil provinces being constantly expanded in the United States, but the area is being doubled every time that petroleum is found in a lower producing horizon. Only 3 per cent of our producing fields have been drilled to basement, and only 20 per cent have been drilled through all the geological beds generally considered to have possibilities. Commercial production is presently being developed at depths below 16,000 feet, and two exploratory wells have been drilled to a depth of 20,000 feet. In the first half of this year we have found some 880 new fields."

Keep in mind, however, "that our resourcefulness in finding new reserves will be limited to the extent that economic controls curtail industry operation. We must, therefore, insist, as a matter of national safety and the future welfare of our people, that we be allowed to keep enough earnings and be given the necessary materials and manpower to continue exploration and development of required facilities to find, produce, and process sufficient quantities of petroleum products to meet the expanding military and civilian requirements." The current outlook in the United States from this standpoint is encouraging. Exploration and development of the Spraberry in West Texas, the Williston Basin in North Dakota, the Uintah Basin in Utah, the Denver-Julesburg Basin in Northeast Colorado-Southwest Nebraska, are expected eventually to uncover vast new oil reserves sufficient to maintain a comfortable margin of available domestic oil for years to come. It is assumed, of course, that equipment, supplies, and manpower will be available. If so, the oil industry of the United States can maintain an adequate producing capacity and ample available oil reserves for national security in the present emergency.

—K.C.S.

FIRST names in pipelines depend on the FIRST* name in line pipe



Constant vigilance means constant quality at the A. O. Smith Pipe Mill. At this inspection station, the pipe is weighed—measured for length—ends checked for wall thickness, diameter and circumference.

A. O. Smith contributes toward lower pipe line installation costs

Uniformity contributes to the quality of the pipe and thus reduces the cost of installation. Uniform, round ends of consistent wall thickness makes for faster lineup in the field—simplifies the welding procedures—reduces total installation time. These are important contributions toward reducing the overall cost of the pipe line—an economic advantage enjoyed by A. O. Smith customers.

To Begin With, plate is used that comes from the mill in uniform thickness and permits careful inspection of both surfaces.

Then our internal expanding process (in use by A. O. Smith for over 20 years) makes certain the pipe is round, straight and of uniform diameter.

Finally complete inspection both during manufacturing process and after finishing makes sure that all pipe shipped meets the high standards established by A. O. Smith.

* **FIRSTS** by A. O. Smith • Welded line pipe • Internal expanded pipe • Light wall large diameter pipe • World's largest producer of large diameter welded steel pipe.

DEPENDABILITY *through* **RESEARCH** *and* **ENGINEERING**

A.O. Smith with 77th ANNIVERSARY 1874 - 1951

A.O.Smith

LINE PIPE • CASING

Chicago 4 • Dallas 2 • Denver 2 • Houston 2
Los Angeles 22 • Midland 5, Texas
New Orleans • New York 17 • Pittsburgh 19
San Francisco 4 • Seattle 1 • International Division: P.O. Box 2023, Milwaukee 1

With The EDITORS . . . . . .

Canada—West Coast Oil Line

A crude oil pipe line from Alberta, Canada, to the Pacific Coast is being favored by the Petroleum Administration for Defense. This is in keeping with PAD's thinking that Mid-Continent oil should supply demands of the Midwest and East, and that Canada should send oil to the West Coast to supplement California's production as needed. Behind this thought, of course, is the fact that by following such a course line pipe will be used most effectively.

It is not likely that the West Coast will feel a shortage of oil for several years anyway; however, a pipe line of such proportions would require a considerable period of time to construct. With this in mind, PAD is projecting its thinking into the future. As 200,000 tons of steel would be necessary for the project, it would not be started this year. There is a good possibility that it may in 1952, however.—F. H. L.

Pipe Allocation

Members of the Division of Transportation of the American Petroleum Institute were privileged to hear George A. Wilson, director of the Supply and Transportation Division, Petroleum Administration for Defense, at the annual meeting in Chicago. His was an intriguing subject: "Steel for Pipe Lines—Who Gets What and When." An intriguing subject because it is one that for months has been uppermost in the minds of those in the pipe line industry.

What Wilson had to say explained in a logical and understandable manner why certain projects had not received all the line pipe needed as fast as needed. He also gave a clear idea of what might be expected.

What have been the bases for allotments to specific projects? Wilson summed up his department's working formula this way: "It is essential that the controlled materials available to the Petroleum Administration for Defense be allotted so as to accomplish expansion where the need is greatest from an overall industry standpoint. Moreover, granted several equally urgent projects, the available materials must go first to those jobs where the most can be accomplished for the smallest investment of scarce material."

During 1951 allocations of steel were far below the amounts requested by the pipe line industry. The impossibility of construction continuing at full pace, in view of the defense program, was expected and understood. What then of 1952? Here, there seems to be a glimmer of light. For the first quarter of the year, PAD was allotted almost as much line pipe as requested. Lest overenthusiasm prevail, however, Wilson pointed out that there are certain factors that will prevent construction of all pipe lines desired, as his figures might suggest. The steel requested represented rock bottom minimums and was by no means adequate to permit allocation of steel for all projects having merit, he pointed out. Also, revalidations of ineffective allotments from previous quarters will use up sizeable amounts of the steel available to PAD in its first quarter allocations.

Wilson's conclusion is that steel will not be available for all pipe line and storage projects in the first, or even the second quarter of 1952. Many good projects that should be finished soon will have to be delayed until late in 1952, and perhaps into 1953, "unless substantial improvement in the availability of materials is achieved." Despite his warnings of premature assumptions there is admission of improvement in the situation, and the tenor is that 1952 will see considerable improvement.

We are certain that Wilson's Chicago talk has left the industry with a greater feeling of cheerfulness, and imparted to it a better understanding of the problems faced by government regulating agencies, and doubtless will result in more genial relationships between the two.—F. H. L.

How Detergent Are Detergents

One major problem in the operation of automotive engines is to keep those engines clean. To attack this problem lubricating oil manufacturers and filter makers both have been at work for two or three decades to eliminate or minimize the amounts of foreign and decomposition material in the lubricating system and to prevent its deposition in the engine.

The result has been the widespread use of addition agents called detergents in crankcase oils, for the lube manufacturers. Filter makers have designed a wide variety of units to be attached to this lubricant system to take out the solids and undesirable non-lubricant material as fast as they form, to maintain the oil in a condition that enables it to perform its function. The detergent materials include soaps and organic materials that maintain the solids and semi-solids in a state of solution or suspension in the oil, preventing deposition and/or coagulation to form solid non-lubricant products. Qualitatively, this job has been accomplished in a manner generally considered quite creditable to the industry.

Additive-treated oils are not cure-alls for all the ills of especially light-duty automotive and similar engines, however, says practical-minded Carl Georgi, veteran Pennsylvania refiner-technologist and authority on lubricants and lubrication. The producer and the consumer of these products must put more emphasis on the limitations of detergents and "high-additive" oils and of "non-additive" engines, and less on super-detergency, efficacious though these oils have been in diesel and heavy-duty gasoline engines, Georgi warns.

Meanwhile Phoenix Chemical Laboratories in Chicago have developed a test for the detergency of lubricating oils, which "holds great possibilities." Phoenix' president Dr. J. Krawetz states. He calls the test a "screening test" and some oil companies and Ralph Matthews' Independent Oil Compounders Association are going along in developing the field and the possibilities. Results of this work should be informative and widely useful.—A. L. F.

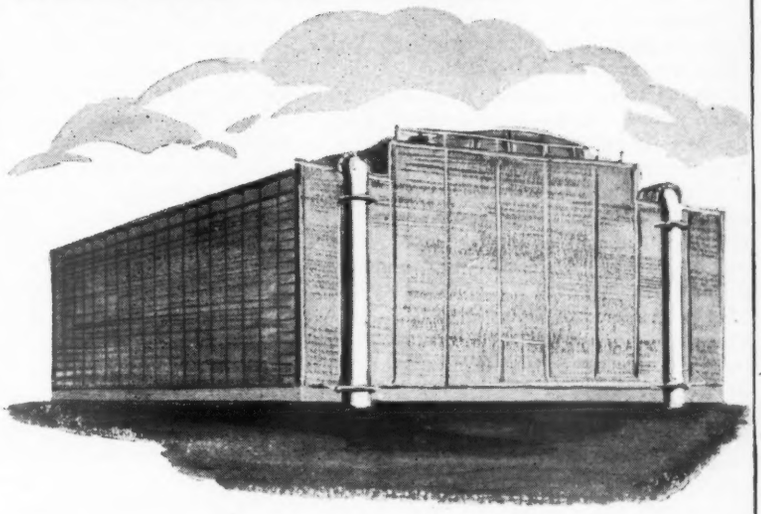
ECONOMICAL, HIGHLY EFFECTIVE

New CORROSION CONTROL

FOR COOLING TOWERS

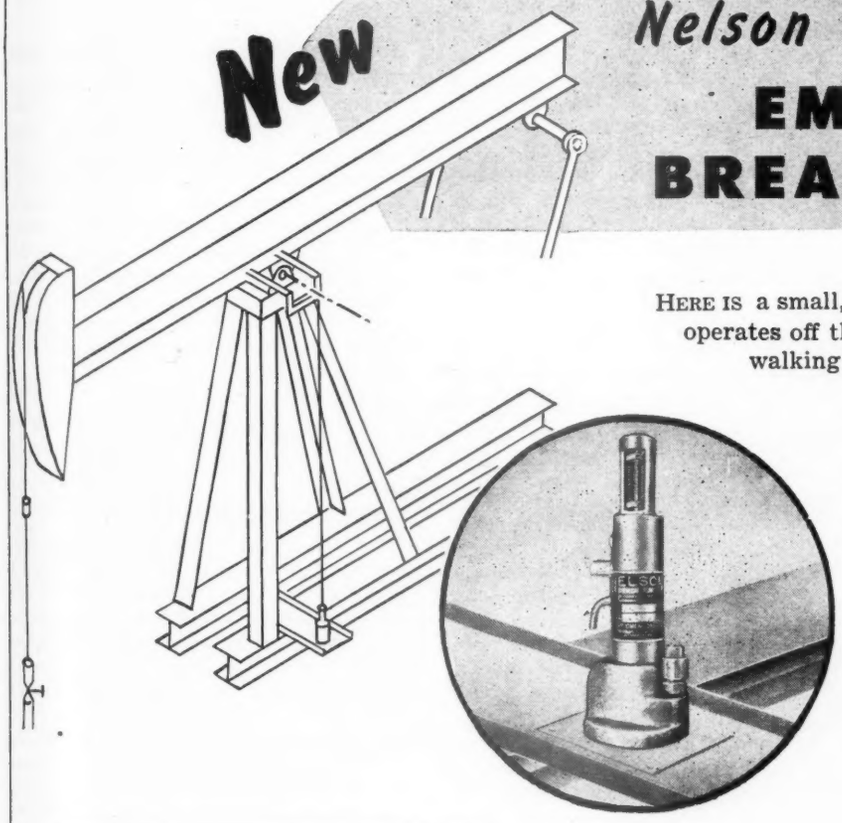
WRIGHT offers new and improved chemicals to solve the cooling tower corrosion-control problem effectively — particularly where certain contaminates are found. Because of the synergistic properties of these chemicals, excellent results are obtained at a moderate cost.

Send for complete information or contact the Wright Field Engineer closest to you. A complete survey will be made and a proposal covering our recommendations and estimated costs will be submitted to you.



New

Nelson Walking Beam EMULSION BREAKER PUMP



HERE IS a small, compact and inexpensive pump that operates off the walking beam. Each stroke of the walking beam activates the piston to inject a predetermined amount of emulsion breaker fluid into the well casing. This pump is compact with air-tight, dust-proof piston-rod packing. The stroke can be adjusted from zero to full, although the piston works to the extremity of the discharge stroke regardless of the stroke adjustment. Sizes ¼ x 1½ and larger (adjustable stroke). Displacement each delivery stroke 0.07 cubic inches. Send for bulletin.

Wright CHEMICALS

WRIGHT CHEMICAL CORPORATION

Specializing in Water Conditioning

GENERAL OFFICE AND LABORATORY—635 W. Lake Street, Chicago 6, Ill.

OFFICES IN PRINCIPAL CITIES

Sole Distributor of Nelson Chemical Proportioning Pumps

HIGHLIGHTS IN OILDOM

TIDELANDS GRAB DENOUNCED

Charges that the oil industry is a gigantic monopoly that evades its fair share of taxation and is "looting" the tidelands were denounced by Hallanan in an address at the annual meeting of the Mississippi-Alabama division of the Mid-Continent Oil and Gas Association, as "falsehoods of base purpose." The speaker branded these statements as part of a "vicious and irresponsible campaign designed to destroy public confidence in the industry and to bring about restrictive and punitive legislation that would impair the industry's strength and render it an easy victim for nationalization.

"Seizure of the tidelands by the federal government was a stunning blow to the national defense effort," Hallanan said. "At this hour, when our military authorities are calling for more and more oil exploration and development, the tidelands are completely barren of drilling rigs. Under state ownership, they would be a beehive of activity."

JOHNSON SAYS OIL CAN REMAIN FREE

Lyndon B. Johnson, Texas senator, told the IPAA in Houston at its annual 2-day convention that if the oil industries fulfills its responsibilites, it can remain free. He stated:

"You will have the freedom you need —so long as you fulfill your responsibility. If you do your job vigorously, continue boldly your search and development of new petroleum supplies, no one else is going to take it over. If you allow your vigor to be sapped by fears, if you allow your boldness to retreat into doubts, if the voice of the petroleum industry sounds like nothing but a chorus of complaints, then the future may become unhappy."

CONNOR URGES USE OF MORE COAL

The U. S. must begin using more coal and less oil and gas, is what Charles W. Connor, defense solid fuel administrator, told the Illinois Mining Institute recently. He told them how this could be done—by supporting Secretary of the Interior Chapman's program for the production of synthetic fuels.

He told the Institute that the U. S. had more than 1000 years' supply of coal, representing about 98 per cent of the nation's reserves of mineral fuel.

Connor reported that the Bureau of Mines has produced more than 300,000 gal of high quality liquid fuels from Illinois coal converted to oil at Louisiana, Missouri, demonstration hydrogenation plant. Only 2.8 lb of steel are needed for each barrel of output from such a plant, Connor stated, compared with 4.6 lb required for each barrel produced from petroleum.

U. S. TO USE SYNTHETIC RUBBER

The United States may soon stop its buying of imported natural rubber latex in favor of synthetics. It has been mentioned several times that the government may sell out its current stocks of natural latex, which it has been collecting for 10 months, but the task may prove difficult as natural latex is much more costly than synthetic. The nation's booming synthetic latex business is largely responsible for this turn in events. About 30,000 tons of synthetic latex are being produced a year by the government, which plans to increase that to 50,000 tons annually within the next 12 months.

CALIFORNIA PAYS TIDELANDS ROYALTY

California has transferred to the Federal government $10,258,000 in tideland royalty funds, and the grand total of what the government claims is $37,505,000. That's the announcement Thomas H. Kuchel, state controller, made in forwarding $2,547,107 to Washington as the latest payment under the U. S. Supreme Court's "tidelands decision" of 1947, which held that the government had "paramount rights" over the California tidelands.

WATER FLOODING RAISES OIL OUTPUT

Dr. M. M. Leighton, chief of Illinois geological survey, has reported that more than 20,000,000 bbl of additional oil with a value of more than $50,000,000 have been recovered from previously abandoned oil fields in Illinois by water flooding oil sands. Dr. Leighton reported that since 1884 a total of 468 oil fields have been discovered in Illinois and 1500 million barrels have been produced. Water flooding will add another 600,000,000 bbl, estimated Dr. Leighton. Last year 4,500,000 bbl were produced by water flooding out of the state's total production of 62,000,000 bbl. Dr. Leighton added that in certain fields, the accumulated recovery by waterflooding exceeds original recovery by pumping.

PHELPS PREDICTS INCREASED DEMAND

Thomas W. Phelps, assistant to the chairman of the board of directors of Socony-Vacuum Oil Company, Inc., reported to the American Petroleum Institute meeting recently that world demand for petroleum products 10 years from now, excluding Soviet Russia and satellities, will be more than 15,000,000 bbl a day, or 4,000,000 bbl more than estimated world demand for 1951. He stated this would mean adding more than 36 per cent to the current demand, and added Socony-Vacuum expected world crude oil producibility to rise from 12,000,000 bbl at present to more than 16,000,000 within the next 10 years, a gain of one-third.

IRANIAN GAP FILLING

U. S. oil fields with assistance from Saudi Arabia and Kuwait have almost succeeded in making up for the loss of crude oil supply resulting from the closing down of Iran's output. At an overwhelming rate of production, Europe and the U. S. refineries are producing enough gasoline to take up where the Abadan refinery quit. The American Petroleum Institute has reported that gasoline inventories are 6 per cent more than 1950, kerosine is 11 per cent higher, light fuel oils, which include the home-heating grades and diesel fuel, stand 21 per cent more, and heavy fuel oil is 17 per cent above last year.

Although the oil situation is not as black as has previously been painted, the Independent Petroleum Association of America has predicted that total domestic and export demand for major oil production for the October 1-March 31 period will be 6.6 per cent over 1950-51.

OIL MEN CAST WARY EYE AT NEAR EAST

U. S. oil men may be getting wary of making new investments in the Middle and Far East. The new tension that makes the industry men feel that any investment may blow up in their faces at any time, has made them increasingly reluctant to invest any additional money as spent in the Eastern Hemisphere for oil exploration. It has been reported by some oil experts that a frenzy of oil searching will hit the Western Hemisphere as a result, from Canada to Latin and South America.

How fast this new oil search gives results depends on steel, agreements with foreign governments, costs of doing business, etc.

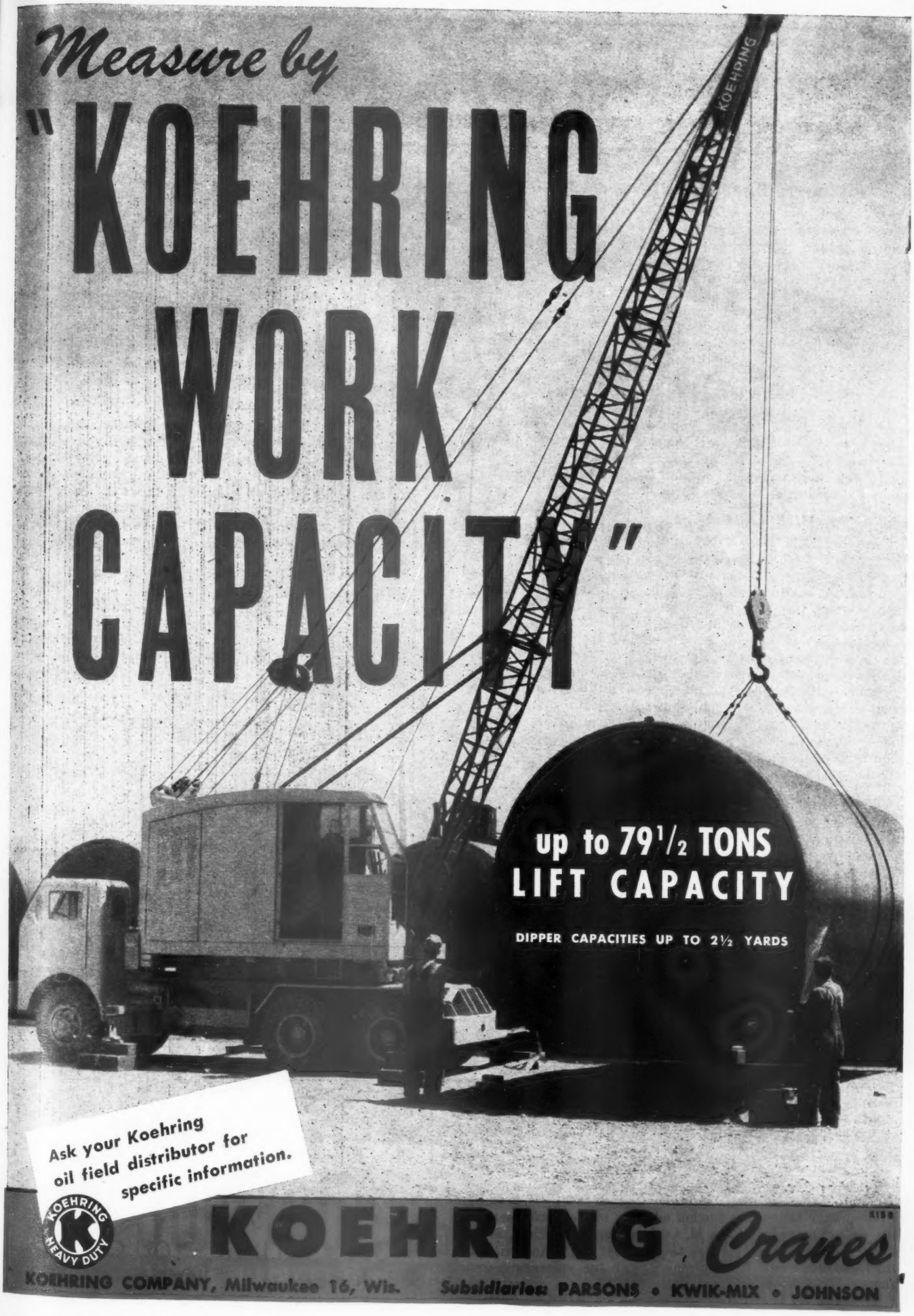
BERATES CHAPMAN VIEWS

Governor Allen Shivers of Texas and Standard Oil Company (New Jersey) president, Eugene Holman spoke out against Interior Secretary Chapman's views on tidelands and synthetic fuels at the API annual meeting in Chicago recently. Shivers stated flatly and almost vehemently "The tidelands belong to the states; the National Administration is trying to steal them, and I'm against it!" He termed the administration's control of the tidelands as "theft without license".

Holman, speaking on synthetics, said the oil consumer would be served best "if the development of synthetics evolves in a normal manner under the influence of straightforward economics." He added that synthetics was the third means of adding to the world's supply of oil. More important, he pointed out are intensive development of domestic lands, and development of oil abroad.

Measure by

"KOEHRING WORK CAPACITY"



up to 79½ TONS LIFT CAPACITY

DIPPER CAPACITIES UP TO 2½ YARDS

Ask your Koehring oil field distributor for specific information.

KOEHRING HEAVY DUTY

KOEHRING *Cranes*

KOEHRING COMPANY, Milwaukee 16, Wis. Subsidiaries: PARSONS • KWIK-MIX • JOHNSON

PETROLIC PERSONALITIES

DICK SNEDDON

HAS HIS OWN HAPPY HUNTING GROUND

Joe Hacker, vice president of the Ladish Company, Cudahy, Wisconsin, is one man who believes in providing his own happy hunting ground right here on earth. He has a farm in Wild Rose on which there are woody woodcocks, ruffled grouse, grouse that never get ruffled under any circumstances, roast pheasant, barbecued duck, deer, and smoked trout. To this refuge he repairs when the going gets too rough, and sitting on the wooded bank of his own private Mississippi with a shotgun by his side and his flyline riding the ripples, he can reach out and help himself to a fish or a woodcock without ever moving from his place. As a matter of fact, the game is reputed to be so thick on the Hacker preserve that Joe has to take a spray gun along with him to keep the birds away while he unhooks his trout. Once, believe it or not, he shot four bucks in a single afternoon —but that was in a gin rummy game. When he pines for the more strenuous existence, he joins his fellow landscape despoilers at the Bluemound Golf and Country Club in their premeditated assault on the good earth.

SAGA OF TULE LAKE

From the Tule Lake area up in the northeast corner of Siskiyou County in northern California, comes exciting word of another mighty nimrod, Johnny Wents, the consultant, who has been making hunting history up that way. Johnny just recently made a quick foray up in the lake country, bagged himself a limit of ducks and geese, and then flew back to Los Angeles to look at his mail, leaving his car behind so that he could return in a day or two and get himself a deer. As is probably already pretty well known, Johnny is an old Stanford grad and he claims that his interest in big game hunting stems from frequent attendance at the annual Stanford-California football fracas which he contends is the biggest game he knows. In addition to being particularly adept with a shotgun, the Wents scion is a domino sharpie with an uncanny faculty for drawing counting rocks from the boneyard.

GEOPHYSICISING ON SKATES

Frank Ellsworth, supervisor for Western Geophysical International, up in Calgary, Alberta, is a Broad Brook, Connecticut boy who has wandered far since he graduated from Worcester Polytechnic Institute in civil engineering in 1937. He had already graduated with a B.S. degree from Trinity College, Hartford and by the time he had completed his term at Worcester Poly was really ready for the road. He worked round his home state for a year or so and then tied up with Western which seemed to be just what he wanted because he has been with this concern ever since. In the meantime he has spent five years in California and Texas supervising seismic parties and another six years in Peru and Paraguay doing the same thing. Frank plays a bit of tennis now and then but can't quite understand why most of his overhead smashes turn out to be lobs. He also plays golf in the low 120's, but his number one love sportswise is winter sport—skiing and skating—which ought to make his Canadian sojourn a thoroughly enjoyable experience. We understand that he can slalom like nobody's business and would probably have been in Sonia Henie's picture. "Sun Valley," only nobody asked him.

A BLESSED EVENT IMPENDS

We discovered to our extreme satisfaction a few nights ago that Wilbur Bettis, more familiarly known as "Bill" is about to become the father of a further addition to the Bettis menage. Bill, export manager of the M. O. Johnston enterprises, is one of our favorite people. He has taken us out on fishing trips on which we have vied for supremacy with the valorous *Germo alalungas*, according to our dictionary "a large pelagic fish of the mackerel family, having pectoral fins." Bill has given a great deal of time and attention to Boy Scouts of La Crescenta-La Canada area and has coincidentally done a fine job of public relations for the oil industry by teaching these boys the virtue of oil, how it is made, and what it means to the national security. He has helped them build scale models of every important unit in the producing and manufacturing processes of the industry and has really done a first class job of selling petroleum people and their methods where it can do the most good. He is one the original founders of Nomads and has never relinquished his efforts in behalf of the organization. How he does it we'll never know but although he has been a long time in the equipment end of the business he looks as if he might have graduated from college about the day before yesterday.

BITS OF THIS AND THAT

By way of last minute roundup, Lou Bronzan, the up-and-coming young Baash-Ross executive, is recovering nicely from a serious eye operation. He had the bandages removed quite recently and is now having the time of his life pottering around the garden for a while before going back to work. It is reported that Bob Cook has been elected a vice president of the Great Lakes Carbon Company. Bill Pemberton, the Los Angeles consultant, is preparing to start out for Africa where he will enjoy a protracted stay studying the flora and fauna. He will report later. Babe Doyle, the Hydril sales executive, and Mrs. Doyle are still in the east. So is Jerry Engstrand, vice president of Grant and MacClatchie companies. Ned Brown has been elected chairman of the Los Angeles chapter of AAODC. Bill Wilson of the Web Wilson Tool Company is in Mexico City as we write and Tom Martin of R. J. Eiche and Associates is just about to leave the same place for home after an extended business trip in Colombia and Venezuela.

SUPERIOR *in all Fields!*

No matter what your operation in the oil and gas industry . . . drilling, production, pipelining, processing or refining, SUPERIOR can give you top-notch supplies and equipment for every need. SUPERIOR covers the field with a complete line of petroleum, gas and industrial supplies, pipe and machinery.

It's good business to deal with a *SUPERIOR* store because you're always close to a complete stock of equipment, operating supplies and expert technical advice. When you need good supplies in a hurry, call your SUPERIOR store.

*Shreveport, La.	*Stephens, Ark.	*Dallas, Texas
*Baton Rouge, La.	*Camden, Ark.	*Abilene, Texas
*Lafayette, La.	*El Dorado, Ark.	*Houston, Texas
*Tinsley, Miss.	*Carthage, Texas	*Tulsa, Okla.
	*Midland, Texas	

NEW YORK CITY — Room 1212 — 502 Park Ave.
Telephone: El Dorado 5-3572

IRON WORKS SUPERIOR SUPPLY CO. INC. SHREVEPORT LOUISIANA

SUPERIOR IRON WORKS & SUPPLY COMPANY, INC.

1202-04 MARSHALL STREET • P. O. BOX 1800 • SHREVEPORT, LA.

LETTERS *to the* EDITORS

Michigan Plant

To The Petroleum Engineer:

I read with interest your article on ethylene in the September issue of The Petroleum Engineer. I believe, however, you left out the most unique ethylene unit in the country—namely, the one at Dow Chemical Company, Midland, Michigan. This is the only unit using crude oil (Michigan fields) as a starting material. The top 75 per cent of the crude is reportedly fed direct to crackers operating at high temperature (1450 F) giving a high ethylene yield. This plant also has the first commercial hypersorber. Plant capacity (ethylene) is believed to be about 48,000,000 lb per year.

It should be easy to check these figures. This plant is believed to be more unique than the refinery just completed at Fawley.

H. Fairclough

Rockville, Indiana

Editor's Note: Inadvertently this plant was omitted from the final tabulation. We were to carry a correction on that matter, but since receiving your letter we shall publish it instead, believing it will be somewhat more forceful in calling the omission to the attention of readers.

The Error of Their Ways

To The Petroleum Engineer:

Your article "What's Wrong With Being an Oil Company?" is the best thing I have ever read in defense of any industry.

If you were as tired as you said you were, you were surely mad enough to keep the red thread of emotion tingling all the way through.

How interesting it would be if some day Harold Ickes, Drew Pearson, and Harry Truman should stumble, arm in arm, into your office, and that you should have the opportunity to indicate to them, in a nice gentle way, the error of their ways.

More power to your pen.

Archibald E. Smith

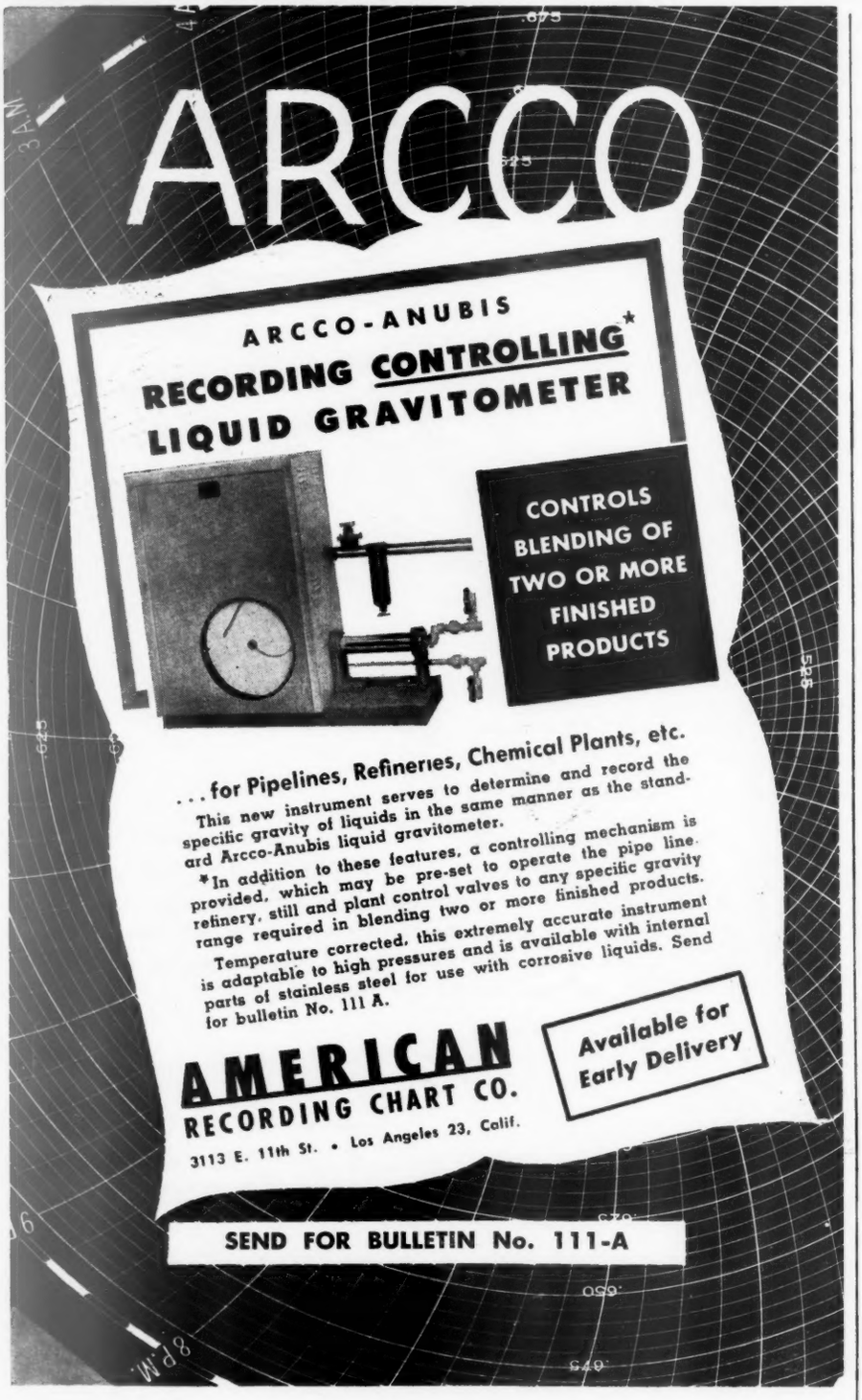
To The Petroleum Engineer:

Your little pamphlet, "What's Wrong With Being an Oil Company?" is very interesting but misses the target. There is nothing wrong with an oil company, there is plenty wrong with our Government now in the hands of one of the most corrupt administrations this country has ever known. The chief motivation appears to be personal ambitions, greed and selfish aspirations; the welfare of our people and our national security are matters of secondary importance.

It is time to prepare to defend our country against the crackpots who seek to turn our system of free enterprise into Socialism. If the Washington mal-Administration is to be replaced by an honest one, now is the time to fight. I do not know whether a Republican victory is the answer, but I do know that any *change* in our political setup will not be for the worse, it couldn't be!

It seems to be the aim of the Washington socialists to drag us all down to a common level, the aim of this group of politicians is to penalize superior ability and to make robots of our entire population, just as long as these robots can vote. The Du Pont industry, the oil companies, certain food stores, and other successful enterprises are now being attacked under the excuse that they are monopolies in restraint of trade. How about the union labor monopoly? Unless the decent elements pull together to bring back a decent Administration, we are going to follow Great Britain down the drain.

L. W. Neustadter


ARCCO
ARCCO-ANUBIS
RECORDING CONTROLLING* LIQUID GRAVITOMETER
CONTROLS BLENDING OF TWO OR MORE FINISHED PRODUCTS
. . . for Pipelines, Refineries, Chemical Plants, etc.
This new instrument serves to determine and record the specific gravity of liquids in the same manner as the standard Arcco-Anubis liquid gravitometer.
*In addition to these features, a controlling mechanism is provided, which may be pre-set to operate the pipe line, refinery, still and plant control valves to any specific gravity range required in blending two or more finished products.
Temperature corrected, this extremely accurate instrument is adaptable to high pressures and is available with internal parts of stainless steel for use with corrosive liquids. Send for bulletin No. 111 A.
AMERICAN RECORDING CHART CO.
3113 E. 11th St. • Los Angeles 23, Calif.
Available for Early Delivery
SEND FOR BULLETIN No. 111-A

THE Petroleum Engineer
DECEMBER 1951

FREEDOM'S OIL*

Because research has found a friendly climate in the U. S., the oil industry has exercised its initiative to provide us our cheapest luxury

LT.-GENERAL ERNEST O. THOMPSON†

In 1924 it was my privilege to attend your Fort Worth convention. Some of you will recall that Henry L. Doherty there attempted to explain his views on oil reservoir behavior and its proposed control. He was not given the floor to make a public presentation of his views to the convention from the platform, but he did considerable presenting of his views to any and everyone he could get to listen to him. He was completely imbued with his theory of oil reservoir characteristics. His was the inventive mind of the researcher. He had unbounded enthusiasm for this theory of his about the use of gas-oil ratios and compulsory unit operation of an oil field. It was my very good fortune to know him and to have listened to him with a completely open mind. It was a new and challenging theory to me.

Because I was a good listener, Doherty gave me a lot of his time there in Fort Worth. When the convention adjourned, we went down to the depot together to take our respective trains for home—Doherty to New York, and I to Amarillo. Doherty said: "Ernest, it's not time for our train departures. Send your grip to your pullman and you come on to my car, and we will continue our discussion."

I gladly agreed. The next morning when Doherty's train rolled into St. Louis, he was still telling me about his theory of reservoir gas-oil-ratio control. He had been talking, and I had been listening to that genius all through the night. My baggage about that time was arriving in Amarillo.

The reason Doherty was not given the floor at Fort Worth was doubtless because the API directors did not at that time go along with his new idea of compulsory unit operation of oil fields. It was too new. What we think we know often blinds us to knowledge.

He did get a public forum before the American Institute of Mining and Metallurgical Engineers in New York in February 1925.

In 1927 the American Petroleum Institute appointed a committee under E. W. Marland as its enthusiastic chairman, known as the Gas Conservation Committee, meeting in Ponca City, Oklahoma, in September and again in October 1927. This committee work resulted in a paper entitled "The Function of Natural Gas in the Production of Oil" by H. C. Miller, which was published by the American Petroleum Institute in 1929.

It is in a large measure to the persistent work of Henry L. Doherty and E. W. Marland that we owe so much today in our advance toward reservoir control. At last we are getting conclusive results in greater oil recovery.

How difficult it is for science to forward itself even for the great benefit of mankind.

Happily, today, we are not so averse to new ideas. I well remember the troubles I had in 1932 when we shut in the East Texas field to take bottom-hole pressures. The operators and landowners resisted in the efforts of our commission in court and on the ground. But we shut in the field for 21 days. During this shut-in period the field gained 14 psi in reservoir pressure. We opened the field again at greatly reduced rates of flow; and, after 3 months' operation, shut the field in again for 21 days and again had the same increase in bottom-hole pressure—thus proving a natural law was at work in the reservoir and available for conservation's utilization.

Today research in your laboratories is bringing forth the newer and fuller life for our people. Your researchers point the way to better methods.

We have been learning how to get ever-increasing percentages of the oil in place. In East Texas we have already recovered 2.8 billion barrels where only 1 or, at most, 2 billion barrels of oil were expected as ultimate recovery. We produced the last 1 billion barrels with an accompanying increase of 18 psi reservoir pressure. The experts now tell me we shall get an additional 2.6 billion barrels from this field. This illustrates *true conservation, which means wise, efficient use of the motivating energy in the reservoir.* Conservation does not mean the hoarding of our oil and gas. It is *wise use* of oil and gas energy. We are there pursuing secondary recovery by reinjecting the salt water produced with the oil back into the reservoir on the side of water intrusion coincidental with the primary flowing and pumping

*Presented at the general session of the American Petroleum Institute, Stevens Hotel, November 7, 1951.

†See page A-35 for biography of Lieutenant-General Thompson, who received the API Distinguished Achievement Award.

operation. The East Texas field was 21 years old October 5, 1951. Today it has 11,950 flowing, and 9579 pumping wells producing 280,000 bbl of oil daily.

Secondary recovery should start as soon after discovery as the producing characteristics of the reservoir are known, if you are to get ever better recoveries. There is the conservation challenge. It is the researcher's job to improve our reservoir-control technique.

Oil for 1975

Herein lies a great untapped reserve of oil for the future—I mean hidden oil, left behind in old thought-to-be depleted fields where not more than 15 or 20 per cent of the oil was recovered by methods then in vogue, the old unrestricted open-flow days. There are perhaps 75 billion or more barrels of oil in these old oil fields waiting to be loosened from the rocks.

I know of an excellent example where by water-flooding a field which was about to the point of economic abandonment—the wells having gotten down as low as 2 bbl a day, and one was a 5 bbl well—the new operators have got the 2 bbl wells up to 200 bbl daily, and the 5 bbl well is now making 500 bbl per day. Already in a few months this field has produced by water flooding more oil per acre that was recovered in the primary flowing and pumping stages of production over a period of 21 years.

In the past 25 years we have supplied all demands for oil, and have constantly built up our reserves. Certainly, with all your research and with ever better drilling and conservation practices in production, we can be assured that, come 1975, you can look back with even greater pride than you take in surveying the period 1926 to 1951. The next 25 years can be supplied with petroleum easier than the past quarter century was supplied.

Research Is American Tradition

Sometimes we overlook the fact that research has been a part of American tradition.

Benjamin Franklin on his many crossings of the Atlantic, representing young America, dropped a canvas bucket over the ship-side several times a day, testing and recording the temperature of the sea water at that location.

He read the barometer and noted its change; recorded the mileage from day to day, the wind directions and velocities. And then in 1786, when he had facts enough to warrant generalization, and leisure to organize and examine them, he sat down and made the first map of the Gulf Stream.

For 200 years mariners had known there was a northeasterly current somewhere in the North Atlantic, and that sailing with it was easier than sailing against it. But it remained for our first minister to France to carry on the studies which made it possible to locate the current, and then—in the spirit of the true scholar the world over—to publish his findings for the benefit of all mankind in the *Transactions of the American Philosophical Society*.

In 1860, when Lincoln was preparing his "Cooper Union address," he wished to know exactly what each of the 39 signers of the U. S. Constitution had said or done relative to federal control of slavery in the territories. In the search for an answer to this question, he carried on meticulous historical research. When he had his facts, he presented them in such fashion that this address—more than any other utterance or publication — sent Lincoln to the White House and Douglas to oblivion.

Yes, the spirit of research—the spirit that "wants to know" — is native to America.

Research has found a friendly climate here in this democracy of ours—perhaps the most congenial in the world.

Oil and Gas Conservation

Man does not waste that which he can presently profitably use or readily sell at a profit.

We have many wise conservation and waste-prevention laws, rules, and regulations. Our Texas legislature, in line with the lawmakers of the other 21 oil-producing states, has kept abreast of technological advances in the production of oil and gas through the meetings of the Interstate Oil Compact Commission. Full credit should go to the lawmakers and to our splendid courts. They chart the course.

Price Is the Greatest Conservation Agent

Do not allow this industry to be seduced by a subsidy! A fair price in a free competitive field is the greatest incentive to prevent waste in oil and gas production. The better the price, the more exacting can be your conservation practices.

To illustrate more clearly, I shall use the example of flare-gas-casinghead gas produced with and as an incident to oil production from oil wells.

In days past gas had no sale value because there was no market for it. With the advent of the gas pipe lines from Texas to outside markets, natural gas began to take on market value due to competitive market demand for this clean, efficient, convenient fuel.

Our commission accordingly required that this casinghead gas be gathered from each well to a central plant where the more easily liquefied hydrocarbons were removed, and then we required that the gas be returned to the oil-producing reservoir to lift more oil, or that the gas be utilized for light or fuel or for manufacturing or for some other lawful purpose. No oil was allowed to be produced unless the gas was saved for use.

This is pure waste prevention. The oil industry has already spent some $300,000,000 erecting such conservation systems in Texas. We are saving 2 billion cubic feet of gas a day and recovering 358,996 bbl daily of liquid hydrocarbons. This is in addition to our crude production of 2,870,000 bbl daily and 12 billion cubic feet of gas daily.

Our market-demand statute in Texas says: "Production of oil or gas in excess of market demand or transportation facilities is waste, and is forbidden." We allow to be produced all the oil and gas that can be sold ratably and carried on hand in storage aboveground. This law, properly administered, protects the consumer by providing plenty of crude, and prevents physical waste of oil and gasoline in excess storage.

I know of no business that is more keenly competitive than is the oil and gas business in all its branches. It is an open field where anybody can get in if he has the money and the courage to lose it hunting for oil or refining or marketing it.

Oil Hard to Find

The search for oil is a hard one. New-discovery or so-called wildcat wells are successful only one in nine holes. Eight out of nine efforts are failures—dry holes.

The chances of finding even a very small oil field are 1 in 16 tries. By a very small field I mean one that would supply the United States with oil for only four hours.

The chances of finding a small field are one in 53. Such a field would supply the United States two days.

The chances of finding a medium-sized oil field are one in 330 tries. Such a field would supply the United States one week.

The chances of hitting a major oil field are 1 in 991. A major oil field is one which will produce over 100,000,000 bbl of oil in its life.

The average cost of a wildcat well in the United States, including all exploratory developments and necessary overhead expenses, is approximately $90,000. Many of them cost $500,000 up to $1,000,000, and then prove to be dry. Only tax-depletion recognition makes such efforts possible—and, remember, the depletion comes only out of profit you make, if you make it.

Depletion is the recognition that every time you take out 100 bbl of oil there is just that much less oil (capital) in your reserve under the ground.

If the people generally knew these facts, there would be no effort made to change the law; I mean there would be no successful effort possible in the face of an informed electorate.

The people are fair when they are fully and correctly informed.

Congress Oil-Policywise

Twenty-five years ago, in 1926, the Congress of the United States enacted the percentage-depletion law as applied to oil and gas for 3 purposes: To assure continuing abundant supplies for an expanding economy; to assure equitable taxation of the petroleum industry; and, to provide adequate oil reserves for defense.

This wise depletion recognition on

TEXAN AWARDED API 1951 MEDAL FOR DISTINGUISHED ACHIEVEMENT

LIEUTENANT-GENERAL Ernest Othmer Thompson—soldier, lawyer, petroleum expert, and public official—has exercised a tremendous influence on development of the vast program for conservation of this nation's precious oil resources. First appointed to membership on the Texas Railroad Commission in 1932, when that regulatory body was struggling with problems caused by the opening of the rich East Texas field, General Thompson was re-elected in 1948 to a 6-year term that will continue through 1955. During that period he has played a leading role in the development of the Interstate Oil Compact Commission and in the perfecting of techniques for obtaining far larger quantities of oil from the ground than was thought possible two decades ago.

General Thompson was born in Alvord, Texas, March 24, 1892. He has been a resident of Amarillo ever since his family moved to that city in 1900. General and Mrs. Thompson, the former May Peterson, Metropolitan Opera prima donna whom he married in 1924, also maintain a home in the Texas capital city of Austin.

Educated in Amarillo public schools, Virginia Military Institute, Eastman Business College, and the University of Texas, he won his bachelor of laws degree from the University of Texas Law School in 1917. The honorary degree of doctor of laws has been conferred upon him twice—by Texas Technological College in 1940 and by Texas Christian University in 1951.

In 1932 Thompson was selected by Governor Ross S. Sterling to fill a vacancy on the Texas Railroad Commission, the oil and gas regulatory and conservation agency of the state. The East Texas field had just been brought into prolific production. The National Guard had been called out and martial law declared there in a desperate effort to establish orderly production. As a result, Thompson's military experience at once became invaluable both to the state and to an oil industry that was threatened with bankruptcy as petroleum poured out of the ground too fast to be processed, moved, or marketed.

When the U. S. Supreme Court ruled against the use of martial law in the oil fields, Thompson appeared before a special session of the state legislature and proposed legislation for the conservation of petroleum resources. This legislation, which says that production of oil in excess of market demand or transportation facilities is waste and shall be prohibited, was promptly passed. So the day the Texas National Guard moved out, Thompson established proration headquarters for the Texas Railroad Commission in a tent vacated by the commanding general.

When efforts were made in the courts to show that proration was against the public interest, Thompson conducted a personal survey. It proved beyond a doubt that the prorating of fields leads to far greater ultimate recovery than if the wells are allowed to run wide open, thus dissipating underground gas and water pressure.

Lt.-General Ernest O. Thompson

When East Texas came in, geologists estimated that it would produce a total of about a billion barrels under existing production methods. With the conservation system instituted by the Texas Railroad Commission under Thompson's direction, the field already has produced 2,842,865,000 bbl. It also has shown an *increase* in well-bottom pressure due to a commission requirement that water produced with oil be returned to the producing horizon. As the result of such techniques, experts now believe that East Texas will produce 2,600,000,000 bbl of additional oil.

A consistent and tenacious advocate of the dual sovereignty of federal and state governments under the United States Constitution, Thompson always had maintained that states have the exclusive right to use their police powers in protecting their own oil and gas resources. His use of such police powers to stop railroad shipments of "hot oil" out of Texas was supported by a significant executive order from President Franklin D. Roosevelt. A short time time later Congress passed the Connally act which prohibits movement in interstate commerce of oil produced contrary to state law.

General Thompson was one of the authors and founders of the Interstate Oil Compact Commission which furnishes a forum where states can bring about uniformity and advancement in their conservation laws and practices. He has been commission chairman for three terms, and has seen the organization grow and prosper until it has a membership of 22 states and fully occupies that no-man's land between state and federal jurisdiction.

the part of Congress has accomplished all those purposes.

Given a continuance of the opportunity that this time-tested method has provided, in my opinion the industry will continue to find the oil as needed. It will meet the plea of the government for additional oil-producing capacity to supply the needs for defense. Yes, we can supply the nearly 4 million barrels per day for defense, great though that estimate may be. I think we will need about that much. It is safer to have plenty of oil, come war.

As further proof of the wisdom of the 27½-per cent depletion recognition, I should like to point out that in 1926 the oil reserves of the United States in known fields were 8 billion barrels. Now, 25 years later, in 1951, the reserves of the United States in known fields are 26 billion barrels of crude alone, plus about 4 billion more if you include natural gas, "naturals," distillates, and condensates.

During this period of 25 years we not only met our demand, but increased the reserves in known proved fields by 17 billion barrels in crude oil.

During these same 25 years there were produced in the United States *33 billion barrels of crude oil*. Now ponder that carefully. Twenty-five years ago, when the depletion recognition was established by the Congress of the United States, we had in the United States only 8 billion barrels of reserves. Since that time we have produced 33 billion barrels to meet current demand, and now find ourselves with reserves of 26 billion barrels in the ground in known fields. I do not believe that stronger proof could be made as to the wisdom of the 27½-per cent depletion. It works. It furnishes the proper incentive. It is dependable. It should not be tampered with.

Let the consumers know that depletion makes certain a long, ample supply of good gasoline at a low price.

Gasoline Cheap and Better

The average price today of gasoline in 50 cities, including tax, is 27.2 cents per gallon. Gasoline, like everything else, is cheaper and better where healthy, free competition prevails under a private-capital-ownership system.

According to the U. S. Bureau of Labor Statistics, the wholesale prices of all commodities have increased since the start of the Korean war on the average 9.9 per cent, while in the same period crude petroleum has increased only eight-tenths of one per cent.

With all of the increase in demand and with a tremendously improved product, gasoline today sells at a lower figure than it did in 1926, tax excluded. Two gallons of today's gasoline does the work of three gallons of 1926 gasoline. In 1926 one bushel of No. 1 hard wheat in the Panhandle of Texas would buy approximately five gal of gasoline. On a recent quotation, October 2, 1951, the same bushel of wheat will purchase 10 gallons of gasoline. In 1926 a 1000-lb steer brought enough money to purchase 360 gal of gasoline, whereas in 1951 a 1000-lb steer will bring in enough money to purchase 1500 gal of gasoline at the retail pump price of regular gasoline. This is not to say that the prices of wheat and cattle are too high today in comparison with other commodities, but it points up the fine job which is being done by the oil industry. Gasoline sells for about 3 cents per pound. What other necessity of life can you get so cheaply?

Again may I say that this is being done under state control of production by your own state officials and by an active industry under the free, competitive, profit-motive system.

It's the American way of life in action. Let's steer clear of federal control, which lays a withering hand on inventive initiative. We do not want security that stifles progress. We do not want any welfare state. All the oil industry wants is a free opportunity in a fair field to serve the people with their oil and gas needs at bargain prices.

We have built America by wise and efficient use of our resources. By wise laws, we have given men the opportunity and incentive to find enough oil to make our great progress possible.

Never in our history has the United States been so rich, so strong, so powerful, and with brighter prospects of going ahead for peace and human freedom in the world.

I feel that a true awakening is taking place in America today, and that we shall in a few years have peace through strength and world cooperation.

ADDENDA

Texas crude-oil production 1932 to November 1, 1951

Year	Barrels
1932	312,478,000
1933	402,609,000
1934	381,516,000
1935	375,617,368
1936	418,775,601
1937	506,066,861
1938	468,781,632
1939	476,550,095
1940	486,661,808
1941	499,208,329
1942	477,828,220
1943	587,436,107
1944	741,126,397
1945	751,045,143
1946	755,899,971
1947	816,188,478
1948	898,313,973
1949	736,626,671
1950	817,044,994
1951 to November 1 (September and October estimated)	823,178,343
Total	11,732,952,991
Thus far in Texas in 1951:	
New oil fields to November 1	481
New gas fields to November 1	58

During my service on the Texas Railroad Commission we have superintended the orderly production of 11 billion 732,000,000 bbl of oil. Today Texas supplies one-half of the U. S. requirements and produces one-fourth of the world oil. Texas has 131,204 producing oil wells, with a daily production of 2,864,000 bbl of crude and 358,996 other liquid hydrocarbons that would be the crude equivalent of 1,000,000 bbl per day. The Bureau of Mines estimate of demand for Texas crude for October was 2,720,000 bbl daily. We have consistently exceeded this federal estimate so as to be sure there was ample oil for every demand. * * *

S E G President Says Oil in United States Will Last 150 Years

The United States will have enough oil to last at least 150 years, is the opinion of Dr. Sigmund Hammer, president of the Society of Exploration Geophysicists. Speaking at the SEG regional meeting in Dallas, Texas, recently, Hammer declared that our known reserves are greater than any other time in history. He said that the nation used two billion barrels of oil last year, whereas wildcatters and scientists found three billion.

With a 14-year supply of known oil reserves in the U. S., Hammer warned the oil industry would have to work diligently to keep up with national demand, which is increasing at the rate of 10 per cent per year. He added that the world known reserve is 600 billion barrels, with only 100 billion discovered and 60 billion produced to date. The United States, he claimed, has not found half its estimated supply of oil.

Hammer told the group of geophysicists that at the present time 600 teams of geophysicists are at work looking for oil, an increase of 25 per cent since the beginning of the war in Korea.

In discussing the state of events in Iran, Hammer expressed the opinion that conditions in this country would not upset the oil economy of the world as only 3 per cent of the total amount of oil produced comes from Iran.

Despite the increased activity in the oil search, most of the oil is being found in the United States, Hammer reported. He gave what he believed was the reason for this—a free enterprise system. "It's a peculiar American ability probably due to our free enterprise system. We can think boldly and are willing to gamble," he stated.

Hammer is head of the gravity interpretation section of the geophysics division of Gulf Research and Development Company, in Pittsburgh, Pennsylvania.

This year's fifth midwestern meeting of SEG was the Geophysical Society of Tulsa, sponsored by the five midwestern local sections in Dallas, Fort Worth, Midland, Shreveport, and Tulsa. R. W. Gemmer of The Carter Oil Company, Tulsa, opened the first morning's session, followed by Dr. Hammer, and Dr. B. B. Weatherby, past president of the national society, and vice president of Amerada Petroleum Corporation, Tulsa. Dr. Weatherby spoke on "Some Uses and Abuses of the Seismic Method."

The Importance of TECHNOLOGY in Developing Oil Production†

C. E. REISTLE, JR.

ABSTRACT

The paper reviews the growth of the petroleum industry in the United States and the contributions made by petroleum technology.

The effect of developments in exploration, drilling, and production technology on productive capacity are discussed.

The unusual growth in technology is attributed to the free competition between thousands of individuals and companies, which competitive condition has also brought together manpower, capital, and management in making the fine record of the industry's growth.

Historical Notes

Being a Texan, I was not surprised to find after extensive historical research that Texas is the birthplace of the white man's oil industry in America. This memorable event occurred in 1543 when the De Soto expedition used tar from a Texas oil seep to caulk their boats.

Another milestone was the use of natural gas to light homes in Fredonia, New York, in 1821. The birth of our industry of today, however, is generally fixed by the completion of Colonel Edwin Drake's famous well at Oil Creek, Pennsylvania, in 1859. For it was here that the ownership of oil rights in the individual landowner and the drilling of wells under lease contracts were established as the basic legal ingredients of the intensely competitive and aggressive petroleum industry. Here, too, was first demonstrated the competition for leases, for markets, and for technical improvement, all inspired by one motive—profit. As the infant industry spread west searching for other oil seeps, like those at Oil Creek, and drilling them as wildcat ventures, the "oil man" began to emerge as an independent, self-reliant, capable American business man.

Numerous fields were found and developed in the next four decades, but most wells were relatively small producers until on January 10, 1901, a single well roared in producing 75,000 bbl of oil per day. This was nearly half as much oil as could be obtained daily from all of the rest of the oil wells in the country. Thus, Captain Anthony Lucas's Spindletop well ushered in the day of "gushers" on the American oil scene.

Petroleum Industry—1951

Today the domestic industry is producing nearly 7,000,000 bbl of crude oil and natural gas liquids per day and is marketing natural gas with a heat value equivalent to another 2,800,000 bbl. The domestic "working stock" of proved reserves amounts to 29½ billion barrels of liquid hydrocarbons and natural gas equivalent to 31 billion barrels of oil. In addition, leases for prospecting, which are the oil source of the future, cover one in every nine acres in this country.

The development of the vast markets required to support the production gains of the past half century is a subject in itself. However, future historians will surely note that demonstrated ability to meet every demand in full and on time was a major factor. History will also record petroleum's continuing ability to compete with other fuels on a cost basis; the natural advantage of its products as clean, convenient fuels; and the impetus furnished by the development of the internal combustion engine.

Today, petroleum and its constituents provide the lubricants for our industrial empire, the fuel for our 50 million automobiles and trucks and for our modern planes and ships, and the heat for 19 million homes. Petroleum also supplies the raw material for our rapidly developing petrochemical industry, our only dependable source of rubber in time of war, as well as fuel and ammunition for defense. Proof that the dynamic petroleum industry has earned its place as a citizen of the American industrial state is reflected by a recent publication of the Institute, "Oil—Key to Progress and Security." This publication graphically shows that in our nation: Oil is food, oil is transportation, oil is ammunition, and oil is the foundation for the future. It also shows that, when compared with other major segments of our economy, oil pays over 20 per cent higher wages and 36 per cent higher federal and state income taxes—based on gross income, but has consistently held price increases below the general trend. No industry could ask for a greater tribute to its accomplishments than the following excerpt from a letter dated November 10, 1945, from the Joint Chiefs of Staff, Army-Navy Petroleum Board, to Ralph K. Davies, Deputy Petroleum Administrator:

"The Army-Navy Petroleum Board extends to you and . . . the entire American petroleum industry its deep appreciation and admiration for the superb contribution which has been made to the victory of the United Nations by providing in full and on time the vast flood of petroleum products required by the Armed Forces during World War II.

"The fulfillment of this gigantic task was without question one of the great industrial accomplishments in the history of warfare . . ."

Repercussions of World War I

Truly, the growth of the petroleum industry since the days of the Lucas gusher has been phenomenal. Yet even this brief discussion would not be complete if we failed to mention some of the past apprehensions over the adequacy of petroleum supplies.

World War I demonstrated that the military security and industrial progress of the United States was dependent on a stable and expanding supply of crude oil and its refined products. Problems of supply near the end of the war caused many people to question the

† Presented to a Group Session of the Division of Production during the 31st Annual Meeting of the American Petroleum Institute, in the Stevens Hotel, Chicago, Illinois, November 7, 1951.

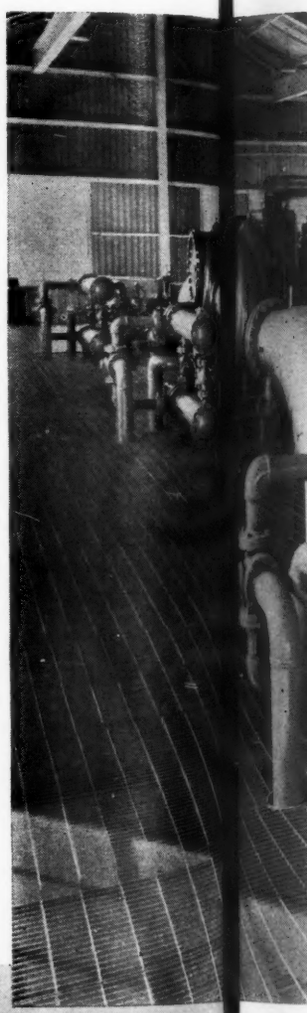
On Transcontinental's half-billion cfd line

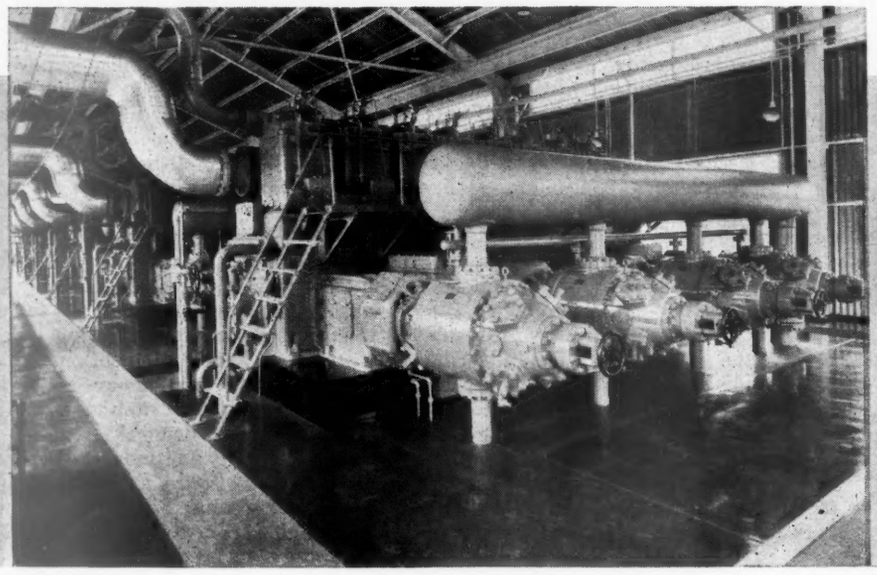
only Clark has both Centrifugal and R

Assigned to the job of handling 555,000,000 cfd of gas thru-put in eight Transcontinental Gas Pipe Line Corporation's compressor stations are 3 steam turbine driven Clark Single Seal Centrifugal Pipeline Compressors and 49 Clark BA-8 and HBA Gas-Engine-Driven Compressors, representing a total of 96,380 installed brake horsepower.

But to Transcontinental, like numerous other gas pipe line companies, these 52 Clark units represent far more than fulfillment of required capacity and horsepower. Primarily, they represent *proved performance, proved design features.* For it was Clark that originated the single seal centrifugal compressor — designed specifically for gas transmission pipe line work. And it was Clark that designed the first big reciprocating pipe line compressor, the BA.

In any large volume application, it only makes sense to seek recommendations from the company that builds both . . . large gas-engine-driven reciprocating compressors and large centrifugal pipeline compressors. That's the only way to be assured of an unbiased analysis. For each has its distinct advantages under certain conditions. Only Clark engineers *can* give you that unbiased analysis, for Clark *builds* both.

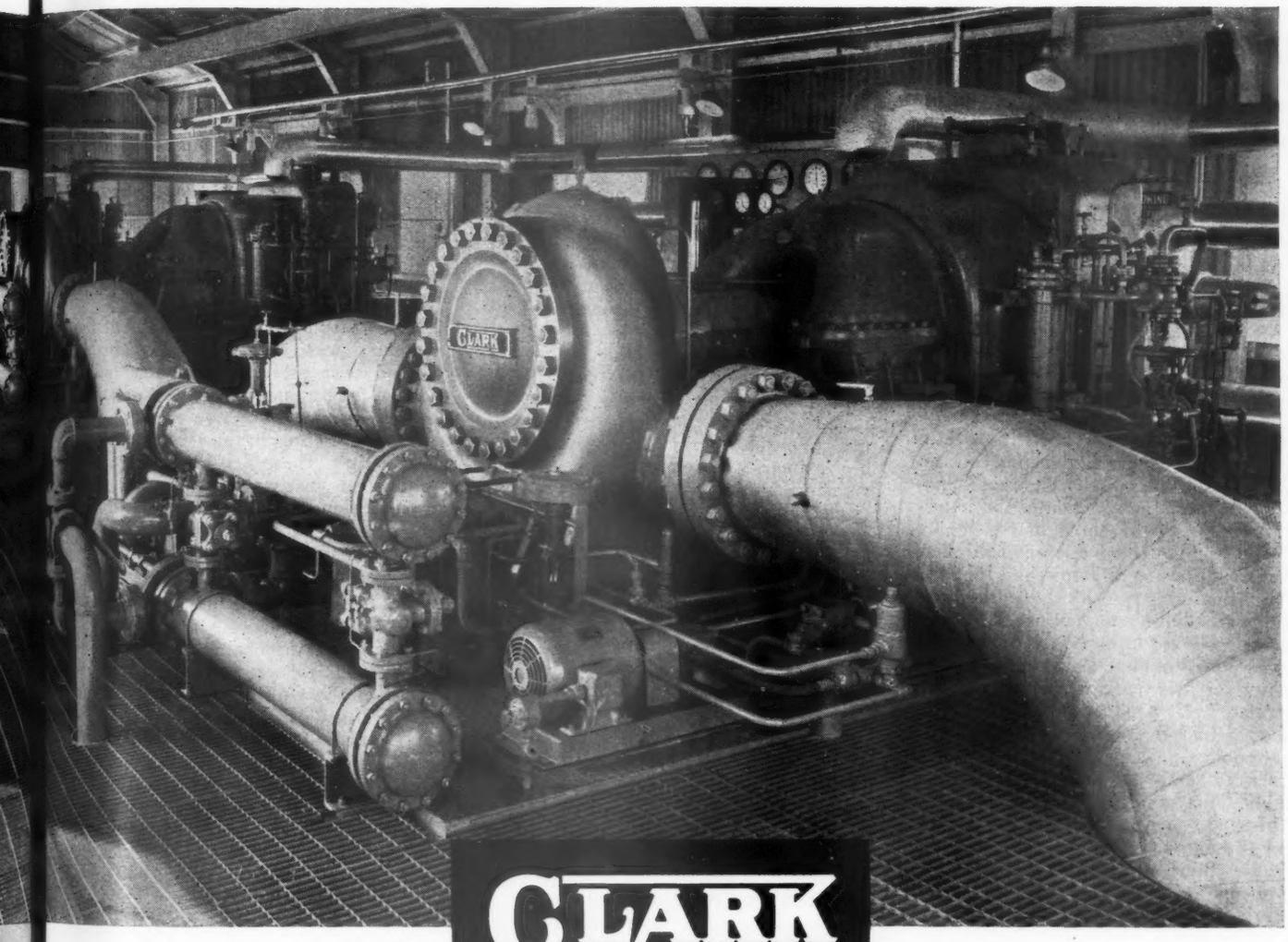




Three, steam turbine driven, Clark Single Seal Centrifugal Pipeline Compressors representing a total of 16,860 BHP, installed on the Transcontinental line at Billingsley, Alabama.

Seven Clark Big Angle, Gas-Engine-Driven Compressors with a combined total of 11,200 BHP installed on the Transcontinental line at Orange, Virginia. Forty-two other Big Angle Compressors power other stations.

Reciprocating Compressors



CLARK®

There's a BIG difference in...

COMPRESSORS

CLARK BROS. CO., INC. • OLEAN, N. Y.

One of the Dresser Industries

New York • Tulsa • Houston • Chicago • Boston • Washington • Pittsburgh
Los Angeles • Birmingham • Detroit • Salt Lake City • San Francisco • Buffalo
London • Paris • Varese, Italy • Ankara, Turkey • Buenos Aires • Caracas,
Venezuela • Lima, Peru • Bogota, Colombia • New Delhi, India • Rio de Janeiro
Calgary, Alberta, Canada • Brussels, Belgium

adequacy of the future supply. This fear of early exhaustion of oil reserves was fed fuel by those who measured the future availability of oil in terms of the number of years that the known proved reserves would supply the rate of production. In 1918, the United States Geological Survey estimated proved reserves at less than 7,000,000,000 barrels. Also, it was predicted that crude production would reach a maximum in 1920 or 1921 of around 400,000,000 bbl per year and then gradually decline. Mr. Kettering of General Motors expressed the concern felt over the industry's ability to continue to meet market requirements by stating before the Institute in 1920 that the only cloud on the internal combustion engine horizon at that time was the question of the adequacy of the fuel supply.

In 1924, public attention was sharply focused on the question of future oil supply by President Coolidge's appointment of the Secretaries of War, Navy, Interior, and Commerce as a Federal Oil Conservation Board to investigate "... ways and means of safeguarding the national security through conservation of our oil..." The appointment of this Board stimulated the controversy then current over the status of United States oil reserves and the producing practices of the industry. I am sure that many of you will remember the vigorous contentions of some that Federal regulation was necessary to prevent wasteful dissipation of our diminishing oil resources, and the equally vigorous opposition of the major portion of the industry, which, as presented in the report of the Committee of Eleven, held that crude supplies were ample and that the ills of the industry could be worked out without Federal intervention. The Conservation Board in its 1926 report recognized constitutional limitations on the power of the federal government to regulate oil production and recommended that the several states exercise their police powers to prevent wasteful practices and to protect correlative rights. This same report, however, also expressed concern over future supplies and presented an estimate that proved reserves were at the precariously low level of only 4½ billion bbl, or a theoretical 6-year supply.

Although there has been many a dry hole drilled since that time, the record of the industry, to date, has repeatedly disproved the dire prediction of inadequate petroleum fuels. This is amply demonstrated by the flood of crude that was called forth during World War II and thereafter to supply the unprecedented peacetime demand. It is also worthy of note that the 4½-billion-barrel crude oil reserve of 1926 has grown to 25 billion barrels despite the interim production of 31 billion barrels.

Review of Industry's Growth

For those of us who play a direct part in the working of this giant industry, the past record of accomplishment seems ample proof that the industry can and will in its free, competitive operations generate the capital, energy, and "know-how" to continue to supply the fuel and lubricating demands of the American Way of Life. As in the past, however, there are many today who divide the working stock of proved reserves by current production and sound the cry of doom. For this reason, it is fitting for us today to review briefly our past record with the view of determining (1) those basic ingredients that are primarily responsible for our increasing ability to find and produce crude oil and natural gas to meet the ever-growing demands of war and peace and (2) whether the same basic ingredients offer security of supply in the foreseeable future.

The Author

C. E. Reistle, Jr., director in charge of the production department, Humble Oil and Refining Company, has been an employee of the company since 1936. Author of numerous technical articles, Reistle is a graduate of the University of Oklahoma. His oil career began immediately during summer vacations while still in college with the Carter Oil. Upon graduation he joined the U. S. Bureau of Mines as a petroleum chemist at the Experimental Station in Bartlesville, Oklahoma. He was elected to the board of directors at Humble in 1948.

Exploration

Colonel Drake and his associates gained their place among the first technicians of our domestic oil industry by proving the theory that a well drilled with proper respect to an oil seep could be expected to yield much more oil than the original seep. They also added power in the form of a steam engine to the oil technology the Chinese began with their manually operated spring-pole. For several years thereafter, the oil seep, coupled with prospects based on oil and gas shows in water wells, constituted the industry's finding technology. Wildcat wells based on hunches, divining rods, and perseverance also made their contribution. As seep prospects were limited and hunches expensive—except for fortune's favored few—the demand for improved finding technology mounted and in the early 1900's the anticlinal theory became the first scientific basis for exploration. Spindletop in 1901 marked the advent of the salt-dome trap, and other structural traps, such as those formed by fault lines and unconformities, were soon recognized.

During the first two decades of the 20th century, surface and subsurface geology came into its own as the guiding light of exploratory effort. The early 1920's brought core-test wells into common usage as an aid in delineating structures that could not be defined by surface geology. Micropaleontology also found its place in identifying the small rock cuttings that were bailed from cable tool wells or circulated to the surface by the increasingly popular rotary drilling machine.

Much oil has been and continues to be found by application of the early techniques of surface and subsurface geology and even by the expensive hunch technique. However, after the more easily found structures were tested by the bit to the practical drilling depths of the early 1920's, the need for new exploration methods became apparent. This was particularly true in basin areas with thick sedimentation, whose subsurface structural features were not revealed by surface topography or were nonconformal with the shallow beds. The torsion balance was among the first of the various geophysical instruments to come to the forefront and with its successor, the gravity meter, was particularly successful in the location of the salt dome structures of the Gulf Coastal region.

Yet, instrumentation as a tool of the geologist was still in its swaddling clothes until the refraction and reflection seismographs proved their uncanny ability to delineate certain types of subsurface structures in the late 1920's and early 1930's. These developments firmly established instrumentation, or geophysics, along with surface and subsurface geology as a major finding method of the industry. The list of finding tools must also include the oriented core, the dipmeter, and the magnetometer and its airborne version.

The impact of technology on the finding of oil is reflected by the discovery record of the Gulf Coastal area. Prior to 1921, the oil discoveries in this region totaled 1,800,000,000 bbl, of which 58 per cent was due to surface indications. The early geologists were rapidly proving their place in the industry with discoveries totaling 470,000,000 bbl. Three decades later oil discoveries in this region totaled 33,000,000,000 bbl. Of this amount, geology and geophysics had contributed 75 per cent, or 24,500,000,000 bbl.

The firm foundation of exploration technology is constantly broadened by the wealth of information on the earth's internal structure, obtained from thousands of test wells as the industry in its search for oil drills ever deeper in new and old oil-producing providences. Technology is meeting the never ending challenge of finding the deeper and less easily delineated oil traps by continually effecting refinement and improvements in its instruments, its techniques, and in its interpretative procedures. The discovery of 8,350,000,000 bbl of oil in the Gulf Coastal area in the last 10 years, of which 99½ per cent is attributable to geology and geophysics proves that technology is continuing to

meet the challenge. Nevertheless, present exploration technology can only be directed to finding structures favorable to the accumulation of petroleum and, as in time of Colonel Drake, a producing well is necessary to prove a prospect or to hold a lease indefinitely. Each operator is limited, however, in the amount of money he can afford to spend for unsuccessful wildcats and still maintain his competitive position. It is for these reasons that the story of the industry is replete with examples of one operator establishing production from prospects surrendered by others.

Thus, the challenge in our competitive industry has always been not only to find oil, but to find it economically, and here technology shows its greatest value. Last year "rank wildcats" based on technology found oil with one well in eight—3½ times as frequently as random wildcats located without benefit of technical advice.

Drilling

The art of cable tool drilling as practiced by Colonel Drake and his drillers remains essentially unchanged to this day. Nevertheless, the good Colonel would have difficulty in recognizing the modern "spudder" or standard rig as a lineal descendant of his prototype or in believing that such rigs could punch holes 10,000 feet into the earth.

Even stranger to the Colonel would be a method of drilling initiated in the early 1880's when two water well drillers in the Dakota Territory, M. C. and C. E. Baker, began using a horse-driven rotary to turn a bit with hollow drill pipe. They also poured water down the hole to wash cuttings up the drill pipe. By the time the brothers reached Corsicana, they were using a power pump connected to the drill pipe by a hose to force water down the pipe and carry the cuttings back up the hole. A Corsicana rig was moved to Spindletop by the Hamill brothers to drill the Lucas well. There the water which had proved so successful as a circulating fluid at Corsicana failed to get the job done. To remedy this situation, the resourceful Hamills plowed up the bottom of the water pit and started cows milling in the pit to muddy up the water, thereby bringing together all the factors of our present rotary rig.

Half a century of technological improvement was needed before the successors of the Hamill rig could drill to 20,000 ft. For it was necessary that wooden derricks give way to steel and the 30-horsepower boiler to hundreds of horsepower. Metallurgy has played its part in providing drill pipe and casing with physical properties undreamed of in 1900, and structural strength has been designed into all phases of the rig and well equipment. Improved completion practices, along with blowout preventers, master valves, high-pressure christmas trees, and the Perkins cementing technique, have made oil going over the derrick a symbol of the dreaded "blowout" instead of the satisfactory completion of a gusher. But the 20,000-ft hole would have remained a dream if we had left the mixing of the mud to the churning of the cows. The development of a drilling fluid to control the tremendous pressure encountered in the depths of the earth, the sloughing of shales, and the condition of the hole has taxed the field of colloidal chemistry and the ingenuity of the industry for 50 years.

The advent of the rotary rig was a boon to drilling speed and opened areas with thick unconsolidated formations to prospecting. However, it brought the problem of identifying the contents of the formations penetrated since flow into the well bore was prevented by the mud column. This led to the development of down-the-hole coring devices of all types. The high cost of coring and missed cores still left a need which has been partially filled by electric logs, drillstem testers, sidewall coring tools, radioactivity logs, and other devices.

Before we pass from this brief discussion of the drilling business, let us note a few of the important steps along the road to greater and greater efficiency. These include the roller rock bit in 1909, while commercial mud additives for weight and viscosity control came into general usage in the 20's. The 30's marked the advent of the unitized rig—which permitted moving and rigging up in hours instead of days, hard surfacing material on bits, wire-line coring, controlled directional drilling, and filtration control of mud fluids. The next decade marked improvements and refinements in many phases of the drilling business, including the firm adoption of the mechanical rig. An outstanding improvement is the jet bit, which has cut average drilling time as much as 50 per cent in most formations and permitted drilling as much as 2700 ft of hole in a single 8-hour tour. Too, the industry has demonstrated its ability to drill wells in difficult locations. Examples include the development of barge rigs for use on the inland waters and shallow waters adjacent to the shore, and later the development of special floating equipment and hurricane resistant structures to permit drilling in the open Gulf of Mexico as far as 30 miles from land in more than 50 ft of water.

No less impressive have been the contributions to completion problems, such as water exclusion by cement and plastics; sand exclusion by screens, plastics, and gravel packing; the stimulation of well productivity by nitroglycerin, by acid after 1932, and by hydraulic fracturing in recent years, while the gun perforator and later the jet perforator ushered in the day of selective production and multiple completion. Controlled directional drilling, a California innovation, spectacularly proved its accuracy in 1934 when the great blowout at Conroe, Texas, was snuffed out by fluid pumped through the directionally drilled control well. The value of directional drilling as an economical means of developing properties with difficult surface locations has been convincingly demonstrated by the millions of barrels of oil produced from submerged lands lying off the Southern California coast, and more recently, by the tremendous savings made possible by the drilling of multiple deviated wells from offshore structures in the Gulf of Mexico.

Competition has always been strong in the drilling business. Technology's challenge, therefore, has been not only to drill ever deeper, but also to drill ever faster and cheaper. In meeting this challenge, technology makes economically attractive development of fields which only a few years ago would have been prohibitive from a cost standpoint, or even beyond the practical reach of the drilling bit. For example, the industry first succeeded in drilling a 13,000-ft well in 1938. This well required 5 months of drilling operations. We are now drilling 13,000-ft wells in less than 2 months in the same general area. Major progress in shallower areas is also reflected by recent drilling of East Texas Field wells in 4 to 5 days. Drilling time in this field averaged 20 days per well in the early 1930's and 10 days per well was excellent in 1935.

Production

Possibly no industry, going back in recorded history to the time of Noah, knew as little about the occurrence, nature, and behavior of its products as was known about oil in its natural habitat by the oil industry at the turn of the century. As we look back today on a half century of accumulated progress, it is evident that man's curiosity and logic has contributed as much or more to the science of producing oil as to the exploration and drilling phases of the business.

The production histories of older fields and the results of the early accidental and intentional secondary recovery projects supplied the data for early attempts to evaluate reservoir behavior; the incentive came from the bitter experience of watching fields pass from the flush production stage with most of the oil left unrecovered or recoverable only at rates yielding marginal profit. From the pioneering investigations of the early 1920's, gradually evolved the present concept that oil can be efficiently displaced from its natural reservoir by gas or water and that much less recovery can be expected when expulsive forces come principally from the release of dissolved gas. More recently, a better understanding has been gained of the beneficial effects of gravitational forces on the expulsion of oil from certain types of fields. The industry has also learned that in most fields production above a certain critical rate greatly diminishes ultimate recovery, and that it is economically desirable to utilize natural forces to the fullest practical extent in the operation of oil fields. In other fields, maximum recovery, and frequently economically attractive op-

eration, demands supplementing the natural reservoir energy while the field is in its flush stage. In such fields, cooperation of the interested parties is desirable—in some of these fields, even to the extent of voluntarily pooling properties.

Analyses of reservoir behavior also led to the conclusions that in most oil fields one well to 40, 80, or perhaps 160 acres, if properly located, could drain the field as efficiently as wells drilled with derrick floors abutting; and that unnecessary wells not only constitute economic waste, but additional possibilities for substantial losses in reserves through blowouts, casing leaks, or careless completion practices. The destructive fires at Titusville, Spindletop, and other oil fields taught the industry that storage of oil in surface earthen pits is also wasteful and extremely dangerous. This expanding knowledge became the basis for our present state conservation laws, which, among other things, provide for:

1. Restriction of production to rates which prevent surface or subsurface waste, and allocation of production between fields and wells within individual fields.
2. Drilling of wells on spacing patterns adequate for efficient oil recovery, and preventing, except in special cases involving correlative rights, drilling on too dense a pattern.
3. Penalties to prevent the wastage of reservoir energy by excessive production of gas.
4. Employment of drilling and production practices and well equipment adequate to prevent either surface or subsurface waste.

Gone forever is the day when a gas well is blown to the air to bring in the oil or when the first appearance of water in a field is considered cause for alarm.

The Bradford Field of Pennsylvania, where primary operations yielded some 254,000,000 bbl of oil and secondary operations have already yielded 280,000,000 bbl, remains an outstanding tribute to the growing technology of the industry and the persistence of its members. It is the proof that secondary recovery has a major place in our operations. Of even greater significance is the performance of the East Texas field. Here, despite the handicap of unnecessary wells, conservation of natural energy through restricted producing rates and return of the produced water will result in the field's recovering at least 5,000,000,000 bbl of oil and in the maintenance of an efficient productive capacity in excess of 200,000 bbl of oil per day for many years into the future.

Realization and use of the principles of reservoir behavior has demonstrated that technology in production can increase ultimate recovery from the 20 to 40 per cent so common under the open-flow practices of the early 20th century to as much as 60 to 80 per cent of the oil in place in the more favored fields and, at the same time, provide the benefits of stable production. In addition, general acceptance of current recovery concepts has done much to eliminate industry's expenditures for unnecessary development wells which, according to past estimates, drained up to $100,000,000 a year of capital and untold tons of steel away from more useful work.

Although accomplishments of the industry in applying the principles of reservoir behavior have been of great importance to the nation and of major economic benefit to the industry, we are not resting on our laurels. Rather, the industry is continuing to develop the technology required to make it economically feasible to recover at least the same per cent of oil in place from all reservoirs as we now obtain from those most favorably blessed by nature. Such activity is also necessary to permit development and operation of the lower grade reservoirs. An outstanding example of the benefits derived from technological advance is provided by current operations in the low quality but really immense Spraberry reservoir of West Texas. Several million acres of the Spraberry sand may ultimately be productive. Here the cumulative effect of reservoir engineering, wider well spacing, faster and cheaper drilling, and new methods of increasing well productivity has made financially possible a development program which will add billions of barrels to the nation's oil resources. From one to three billion barrels of additional recovery per million acres may possibly be obtained if future technology can but find the key. In spite of the tremendous potential recovery, the economic future of this great field still hangs in the balance as the low per-acre reserve makes drilling a marginal venture. The industry has accepted this stimulating challenge and is actively developing and applying new techniques for more economical drilling and production and more efficient oil recovery which will make available to the nation the maximum possible quantity of oil from this unique reservoir.

Time does not permit discussion of such important phases of our present production activities as well reconditioning work with its specialized rigs; the technology of workover planning; the problems of gas and water fingering and coning; our modern lease tank batteries with automatic flowing of wells and switching of tanks; the complex chemical triumphs reflected by lease oil treating systems; and artificial lifting equipment, including the rod pump, the subsurface electric and hydraulic pumps, and our modern gas-lift equipment. The fact that today's lease pumper has a much clearer concept of the many complex factors which are required for the efficient production of oil than was possessed by the industry as a whole in 1900 is only a small indication of the technological development in the industry.

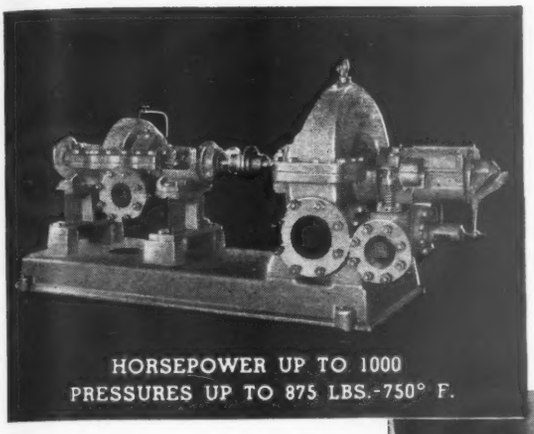
Volumes could and have been written on the benefits of conservation, on the proper utilization of reservoir energy, on the advantages of proper production practices, on the merits of wider well spacing, and on the extra oil made available by secondary recovery and pressure maintenance projects in this country. Yet no volume can more strikingly portray the significance of applied production technology than the simple statement that, had per-well production rates remained at 1920 levels, our present production would require the immediate drilling of 800,000 producing wells. By comparison, the industry drilled 44,000 wells last year and, in the years since Drake's initial well, has completed only 919,000 producing oil wells.

Natural Gas

The use of natural gas for home illumination at Fredonia, New York, back in 1821 probably constituted the earliest commercial exploitation of domestic gas reserves. Today some 13,650,000 homes, 1,175,000 commercial enterprises, and over 50,000 factories and industrial plants use natural gas for fuel. Gas produced from the oil and gas wells of some thousands of operators forms the backbone of the supply for this great market. In bringing this gas to the consuming areas, gas utilities have criss-crossed the nation with over 140,000 miles of natural gas pipe lines, ranging from 2-in. feeder lines to 30-in. mains, and have installed over 170,000 miles of distribution lines under city streets. Since this discussion is primarily concerned with the finding and producing of oil and gas, we can only mention in passing that the widespread market of the gas producer and the 1500-mile main-line moving up to 700 million cubic feet of gas per day became commercially feasible only after such technological developments as high pressure big-inch pipe, the high-pressure large-volume compressor, and after the oil industry developed the gas reserves to guarantee a continuing gas supply for many years in the future. Natural gas in varying quantities has always accompanied the production of oil. This so-called "casinghead gas," along with the nonassociated gas from wells producing only gas, has had an interesting and important place in the development of the oil industry. However, until the problem of economical long distance transportation was solved in recent years, the potential supply has far exceeded the demand for gas in areas remote from large urban industrial centers. Thus, the industry in many areas has had to accept wellhead prices for gas much lower than should be expected, when it is considered that on a heat value basis 6000 cu ft of gas is equivalent to a barrel of oil, and that gas is a much more convenient fuel than either oil or coal. For these reasons, with the possible exception of heavily populated areas, gas has seldom brought sufficient revenue to bear its share of exploration cost.

In the postwar period, the cross-country transmission lines and the public's mounting desire for natural gas in all

Designed with the operator in mind!

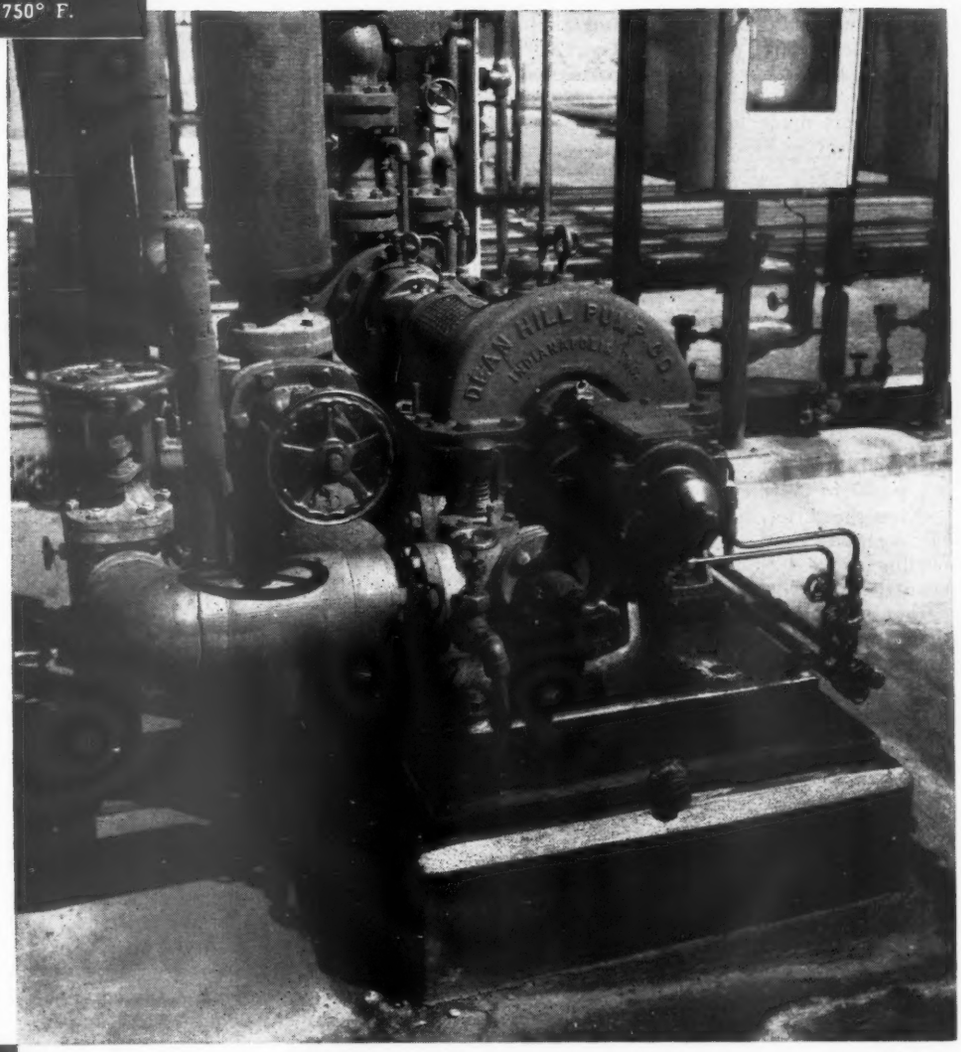


HORSEPOWER UP TO 1000
PRESSURES UP TO 875 LBS.-750° F.

No streamline housings.
No needless cover-ups.
Nothing fancy or frilly about these power-making huskies. Dean Hill Steam Turbines are designed and built for nothing but long service and easy, economical operation. Their heavy, rugged construction is simple and uncluttered for quick, easy maintenance. All pressure parts are outside and visible to operator.

DEAN HILL STEAM TURBINES

.....are single stage, double impact type for low steam consumption. Specifically designed for operation at medium steam pressures and temperatures, DH Turbines have all the advantages available under these conditions, including excellent water rates. Write us for further information and complete specifications.



One of eighty-four Dean Hill Steam Turbines recently installed in a large, eastern Refinery

DEAN HILL PUMP COMPANY

Pump and Turbine Engineers Since 1895

INDIANAPOLIS 7, INDIANA

SALES OFFICES IN:

Chicago • Mexico City • Philadelphia • Salt Lake City • New York • Dallas • New Orleans • San Francisco • Denver • Los Angeles • Pittsburgh • Houston • St. Paul • Cleveland

parts of the country, finally offered the industry hope that gas was ready to take its rightful place as a major product of the industry—able to support competitive prices sufficient to bear its share of the exploration load. However, threatened Federal regulation of field prices on a basis that may amount to confiscation has left the producer wondering if any incentive will remain for technological improvement in the production of gas for interstate markets.

Closely allied with the production and sale of natural gas since its beginning has been the recovery of natural gas liquids. Aside from simple separation, liquid recovery processes have included charcoal absorption, compression, combination compression-refrigeration, and finally modern oil adsorption. Two factors have played a major part in this evolution of the casinghead gas plant; first, the expanding technology of the liquid recovery process, and second, but no less important, the stabilization of oil production. This latter factor furnished the gasoline plant operator a reasonably stable source of gas for many years in individual fields. Their combined effect made financially attractive the heavy investment required for modern plants with their highly efficient recovery processes. Few of the plants of 1920 could hope to recover any butane and only 50 to 60 per cent of the pentanes plus, while our latest plants recover 100 per cent of the butane plus, 85 to 90 per cent of the propane, and, where a sufficiently attractive market is available, up to 25 per cent of the ethane. This comparison readily shows that the liquefied petroleum gas business with its sales of 3½ billion gallons to 7½ million customers in 1950 is truly a product of petroleum technology.

Even this brief discussion would not be complete without mention of the cycling process which the industry developed to prevent loss of liquid hydrocarbons by retrograde condensation and to provide current income from gas reserves without markets. Technological problems were acute, sweeping efficiency; injection patterns and pattern efficiency; operation of absorbers at pressures of 1800 lb; corrosion; pooling of leases; and voluntary co-operation of all parties in unit operation. Such problems have been faced and solved and thus look small in retrospect, but their solution gave the industry a new process for use in its never ending battle to realize a profit from the hazardous oil and gas business.

The technology which is responsible for the cycling process also developed the data to prove that in most gas fields well spacing common to oil production is wastefully dense and that, except in unusual circumstances, more than one well to 640 acres contributes nothing to ultimate recovery.

Pipe Line and Refinery Operations

It is regrettable that we cannot today examine the equally fascinating role of technology in the development of the pipe line and refining facilities that have so greatly contributed to our expanding productive capacity. Even so, I would like to make passing mention of Samuel van Syckel's construction of a 2 in. 5 mile pipe line from Pithole to Miller's Farm on the Oil Creek Railroad in 1865. This line, a financial failure despite tariffs of $1.00 per barrel, was nevertheless significant as the progenitor of far spreading pipe line systems for crude oil and refined products which now have an aggregate length of 158,000 miles.

Similarly, Dr. Keir's one-barrel still at Seventh Avenue in Pittsburgh has given way to the complex chemistry and soaring towers of the modern refinery. However, simple distillation remained the basis of the refining industry until 1912 when Dr. Burton introduced the thermal cracking process that was to revolutionize refinery operations to meet the mounting demand for gasoline in the period immediately after World War I. This opened the door for the applied research, which permits the modern refinery to juggle the oil molecules by proper selection of pressure, temperature, catalysts, and blending agents so as to produce a remarkably high yield of gasoline with constantly increasing octane rating, butadiene for rubber manufacture, toluene for explosives, and other products too numerous to mention.

Technology—Product of Competition

This brief review of the recent growth of our industry, old even in Biblical times, but still in its infancy in the 1850's when Dr. Keir started distilling "carbon oil" for lamps to use up his surplus stock of "Petroleum, or Rock Oil, a Natural Remedy" and so created a demand that made the Drake well financially attractive, will without doubt recall to many of your minds major advancements, improvements, and early incidents not mentioned here. Even so, the examples given show that through the years the industry has generated a "know how" in the technology of petroleum which has ever been directed at finding new ways of doing what must be done and of doing it at continually decreasing costs.

In this comparison of techniques, as they once were, with those now in common use, it may have seemed that the changes have occurred almost instantaneously; whereas, in reality, with few exceptions, there has been a gradual evolution which has enabled us to maintain a sound financial structure and an expanding productive capacity in spite of the increasingly difficult and complex problems that have been encountered. There is, however, one feature that is quite striking and that is the speed with which new methods have been adopted throughout the industry in an effort to maintain competitive position.

At this point, let us ponder a moment — From what source come all these technological advances? It is highly significant that there is no one fountain of knowledge, but rather that, under the stimulus of a hope for financial betterment, it streams from a multitude of springs.

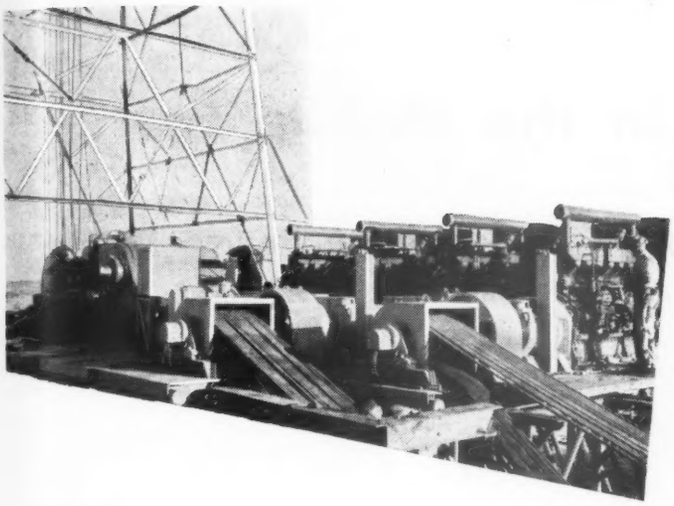
Many and important improvements have come from the suppliers of tools and services, the ingenuity of the driller, and from the thought and enterprise of individuals within and without the industry. Organized research and engineering as carried on by the technologists of oil companies have made outstanding contributions in recent years as we have come to recognize the competitive necessity and financial benefits of research and applied technology, and have provided substantial budgets for these purposes. Major contributions have also come from research, education, and standardization work carried on by universities, government bureaus such as the United States Geological Survey and Bureau of Mines; industry groups such as the American Petroleum Institute, the Mid-Continent Oil and Gas Association, the Independent Petroleum Association of America, and the American Association of Oil Well Drilling Contractors; and such technical societies as the American Association of Petroleum Geologists, American Institute of Mining and Metallurgical Engineers, the American Institute of Chemical Engineers, and the American Society of Mechanical Engineers.

The record of the past is clear—technology fostered and inspired by free competition has always opened new economically attractive avenues for exploration, development, and recovery of oil and gas at a faster rate than those resources have been discovered, developed, and produced.

That the competitive urge—with its multiplicity of technological attack and with its stimuli for the rapid utilization of new ideas and continuous improvement of existing methods—is basically responsible for past progress of the domestic petroleum industry is best demonstrated by the 1,100,000,000-bbl growth in the yearly production of our competitive oil industry in the past two decades. In Russia, which has as great or greater natural resources, the state-owned industry added less than a seventh as much or only 155,000,000 bbl to yearly production is the same two decades.

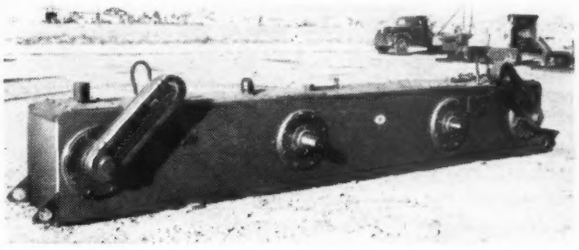
Conclusion

In conclusion, I would like to emphasize that free competition for profit between the thousands of individuals and companies that make up the oil industry has been the driving force that has caused manpower, capital, and management to combine in developing the technology of petroleum. This technology is responsible for our growth. So long as our industry has the incentive of free competition, it shall continue to generate the technology that can and will let us meet every demand for petroleum and its products in the foreseeable future. * * *



SKF-equipped Mid-Continent Supply Company Multiple Engine Rig and Pump Drive.

SKF-equipped Texas Flange Company Drilling Engine Compound.



why do so many prefer SKF?

It's pretty hard *not* to buy good bearings today, but SKF is the preferred bearing with many oil field equipment manufacturers.

There are good reasons why!

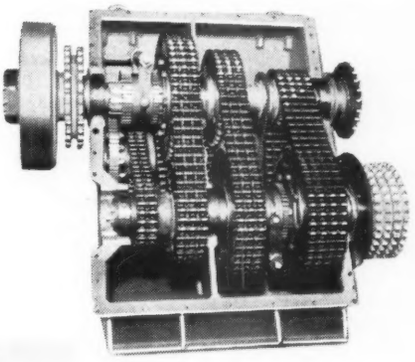
These manufacturers know SKF as a reliable, friendly supplier. They've learned to have implicit confidence in the experienced bearing engineering specialists at SKF's headquarters. They appreciate the teamwork of SKF field men who are qualified specialists in the application of bearings to oil field equipment.

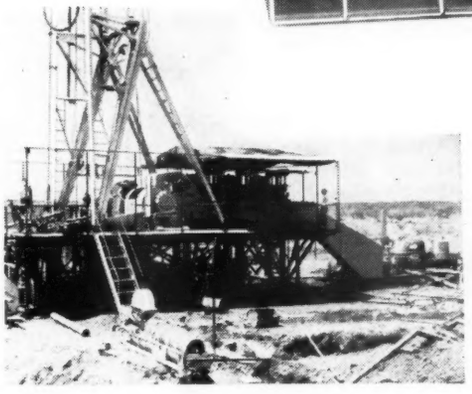
Their customers know the value of the complete maintenance service available to them through SKF's Distributor Organization.

Whatever your product, your engineers and designers can have this helpful SKF teamwork simply by asking for it.

7281

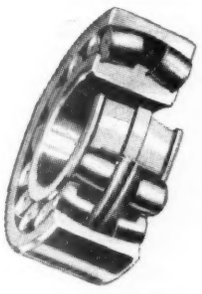
SKF-equipped Cardwell Manufacturing Company Three-Engine Draw Works.





SKF

BALL AND ROLLER BEARINGS



8 REASONS WHY **SKF** IS PREFERRED BY ALL INDUSTRY

integrity • craftsmanship • metallurgy
tolerance control • surface finish
product uniformity • engineering service
field service

SKF INDUSTRIES, INC., PHILADELPHIA 32, PA.—*manufacturers of* **SKF** *and* HESS-BRIGHT *bearings.*

The Oil Problem in the Middle East

Near East oil is of absolutely overriding importance to free world, says Assistant Secretary of State, describing U. S. policy

GEORGE C. McGHEE*

You all know what importance the Middle East has for the United States and its allies. First, there is oil—oil in the most prolific quantities yet found in the world. The 250-mile strip of the Arabian Peninsula bordering the Persian Gulf is now considered to have reserves equal to those of the entire United States. Those of you who have seen a Schlumberger log on, for example, a Burgan well, must have had the same shock I had when I first looked at the 1000 ft of saturated sand. And they have only just touched the surface.

The Arabian-American Oil Company was recently surprised by striking oil in a shallow core drill test out in the waters of the Persian Gulf; the huge oil slick which appeared made it plain to Arabs and oil men alike that the submerged areas might have the same staggering potentialities as the spectacular structures on dry land. I believe Aramco has drilled 13 wildcats, all told. Ten were discoveries of fields averaging a billion barrels reserve. Like all wildcatters, however, they make very persuasive but familiar arguments that the three misses were either "just off structure" or they should have drilled "just a few feet further".

It is the same story in Iraq, Iran, Kuwait, and Qatar—prolific quantities of oil with only a small part of the area thoroughly explored. The companies out there have had to do a negligible amount of wildcatting. Virtually all fields have been located by surface geology. I understand that there isn't any seismograph crew currently operating in any of these four countries. You have all seen the cartoon showing Arabs looking at a drilling rig with the caption under it reading "Just between you and me I wish they'd hit water." That happened in reverse in Kuwait—while drilling for water the Kuwait Oil Company reportedly got oil.

Now, I am not trying to tell you that these fabulous sands and cavernous limestones are directly essential to our own economic life. In absolute terms, they are without doubt the most important oil concentration in the world. But they are not as directly and immediately important to us as East and West Texas and the Panhandle and these derricks and gathering lines right outside your city here. They are not as directly important to us at Maricaibo and Eastern Venezuela and the Williston Basin.

But we cannot look at the big picture of world oil resources and needs solely in terms of our own direct requirements at this immediate point of time. We have to take the broader view of the needs and availabilities of the whole free world. We are a partner and the leader in a community of nations that we have come to refer to as "the free world". As the leading member of that community we are locked in a struggle, half-war, half-peace, that we have come to refer to as "the cold war". Aggression has struck, is still striking, in Korea. It may strike again anywhere, any time. We are engaged in a bitter contest, the end of which is nowhere in sight. In that contest, we are the leading player—the captain, if you will—of a team. We have to think in team terms. We have to evaluate the importance of Middle East oil, not just directly to ourselves, but to the team as a whole.

From this point of view the oil of the Middle East is of absolutely overriding importance.

The free world needs it. Our European allies are particularly dependent on Middle East oil for their industrial machines and their rearmament efforts. European demand for petroleum has doubled since the war; refinery throughput has increased three times. Four-fifths of this oil comes from the Middle East. I don't have to tell you what the impact would be on Western Europe directly and the United States indirectly if we were denied these Middle East oil resources.

Futhermore, we would not be very smart to think of this oil solely in terms of the immediate present. We must look ahead. No one knows how long we will be able to go on producing 6,000,000 bbl a day. We may or may not be able to find new sedimentary basins out of which to increase our production as our needs grow. I am all too familiar with the fate that befalls those who try to double in brass as prophets, and I am not going to expose myself by asserting either that our production will decline or that it will not increase fast enough. It is clear, however, that our needs will grow as our dynamic economy grows, and that we may well come in time to take a quite different view than we now do of the direct importance to us of Middle East oil.

This aspect of our problem is only one facet of a much more general problem of raw materials. I think you will be struck by certain pertinent facts taken from the testimony which Nelson Rockefeller made before the House Foreign Affairs Committee in support of the Mutual Security Bill. He pointed out that although we have only 6 per cent of the population and 7 per cent of the land area of the world, we produced before the war *one-third* of the world's manufactured goods and *one-third* of the world's raw materials. Now, however, we have 50 per cent of the world's manufacturing capacity but produce only the same *one-third* of the world's raw materials. Futhermore, this manufacturing capacity will increase 20 per cent more by 1953, this increase alone amounting to more than the total productive capacity of any single country in Western Europe.

I have spoken to you at some length about the importance of Middle East oil. The Middle East has more than just oil, however. Without an anticline, the Middle East would still be a most im-

This statement by Assistant Secretary of State George McGhee, who has presided over our Middle East policy, will be of interest to those who have followed our diplomacy, which is a vital background for successful oil development by U. S. oil companies.

McGhee is reported to be assigned to the Turkish embassy, which may be officially announced before this issue is delivered. So far there is only speculation regarding who will follow him in the directing role for Middle East policy.

Last event in the Iran move to nationalize its oil production was failure to solve the problem of operating the British installations. When Prime Minister Mossadegh left Washington for Iran after weeks of consultation, no solution had been arrived at.

*Assistant Secretary of State for Near Eastern, South Asian, and African Affairs, speaking before the Petroleum Branch of the American Institute of Mining and Metallurgical Engineers, Oklahoma City, Oklahoma, October 3, 1951.

portant piece of the earth's crust. It lies athwart the air, land, and sea crossroads of three continents. It contains the Suez Canal, a vital artery that keeps the free world connected and communicating. Every major international airline connecting Europe, Asia, and Africa passes through the Middle East. Even its vast deserts and barren wastes of lava and limestone are strategically important. They have historically constituted one of the greatest natural defensive areas in the world. Rommel and Montgomery were only the last generals to have discovered how difficult it is to pursue the enemy into the desert. It is difficult to move armies without water.

So, one, there is the oil; and two, there is the area—but the Middle East has more—it has people. We need people on the side of the free nations. We want these people on that side. We want these people to stay free, to become strong, to be members of the great community of free nations. If these people were to be successfully wooed by our enemies, the Middle East, rather than an asset, would become a strategic weakness in the defense of the free world. The people are more than just a means to an end, however, they constitute an end in themselves. In a very real sense the most strategic area in the world is the minds of men. We seek to win that strategic objective. We wish to prove to these people, most of whom live in conditions of extreme poverty, ignorance, disease, and despair, that the way of the free world offers more and can give more to them in their lifetime than can the agents from the Kremlin or those among them who preach hatred of all foreigners.

The people of the Middle East are beginning to stir, to look for a better way of living. This force is reflected from Morocco to the Far East by a growing nationalism. Although it can be subject to abuses, nationalism is in itself a good thing. Our own history is clear with regard to the advantages of or controlling our own destiny. It has worked well; other people like the pattern and want it for themselves. So our problem with these countries lies in helping to guide this force of nationalism, at the right pace, toward objectives that we and the other free nations of the world are striving for. We must not let the Communists succeed in their efforts to play a spurious role as the champions of national aspirations in these countries. This they are trying to do—with typical cynicism but with some success.

These, then, are the three ingredients of the oil problem in the Middle East—the oil, the area, the people. The three ingredients affect one another in a variety of ways. The oil, for example, is one of the reasons why the area is of such strategic importance. It is the oil—and the wealth it can produce—that holds out to the people their only substantial hope of finding enough capital to finance that economic development they so hungrily desire. Because the area is so important in the strategy and structure of the free world, it is imperative that we do all we can to preserve peace and promote stability in the area. But, in the light of the underdeveloped nature of their economies, the aspirations of the people, and the importance to them of their income from oil, there is a strong tendency for instability and conflict to develop around the arrangements under which foreign companies produce oil. This is what has been happening for these past several months in Iran.

I am sure you will agree that the oil problem in the Middle East, if you consider all of these ingredients, is exceedingly complicated. But out of the maze of facts and relationships I have recited, certain conclusions stand out pretty clearly. Taken together, they constitute, if not the full detail, at least the main lines of our national policy in this matter. Let me state them for you briefly:

1. Our interest in stability and peace in the Middle East area is so urgent that we must constantly seek stability in oil industry operations in the region—the development of relationships between oil companies and governments that, while flexible enough to adapt itself to changing circumstances, will be so firmly rooted in equity and mutual confidence that it can survive and serve the legitimate interests of all parties concerned.

2. As regards the financial terms of oil concession arrangements we have hoped and we still hope that this stability can be achieved along the general lines of the 50-50 formula, that is, the concept that the profit earned by the company that develops the oil resources should approximately equal the total payments to the government of the country that owns the oil resources. This formula has proved itself in Venezuela, it is proving itself in Saudi Arabia and its self evident equity should commend it to men of good will everywhere as a sound governing concept for the long pull. It is not in the interest of oil producing countries to push their revenues beyond the point where operating companies are still willing to take risks and make outlays. A country that does so will lose in the end. When oil from some one country or field bears too high a royalty cost and tax burden relatively to oil from other countries and other fields, its production will not be pushed and expanded. Indeed, this principle is general in its application. In the whole broad field of foreign investment a disposition on the part of the countries needing capital to try to drive too hard a bargain can only retard that flow of capital from developed to underdeveloped countries that it is so much in the common interest to accelerate rather than to retard.

3. Oil development in the Middle East should in general, proceed equitably as between different countries so that no one country can reasonably feel that its economic development is being retarded to suit the convenience of a foreign oil company or that it is getting an unreasonably low rate of compensation for the use of its oil resources as compared with the basis of payment to its neighbors. Otherwise there will be friction, conflicts of interest, and jealousies within the region, and resultant instability.

4. The relationships between oil companies and governments should be embodied in simple and straightforward contracts understandable by the people of the countries. They must not only be fair but they must be demonstrably fair. These contracts should be honored scrupulously by both parties. The doctrine of sanctity of contracts—and the corollary doctrine that disputes arising under a contract should be negotiated and arbitrated in an orderly way through established machinery—is not only of critical importance to sound foreign oil operations but indeed to all foreign investment and international business. It is of equally critical importance to the countries that grant oil concessions. Small countries depend on respect for contracts and observance of proper procedures for their very existence. In the last analysis, so do the most powerful nations. No country can disregard the impact of its policies on the outside world. We are all dependent on one another.

5. The oil of the Middle East should make the largest possible contribution to the real welfare of the people and states of the area. If oil revenues are properly applied they can make possible the economic re-birth of the Middle East. They can finance a sound and durable pattern of economic development. They can help to provide better standards of living through improved housing, much-needed irrigation facilities, a healthy agriculture and the beginning of industrialization. The responsibility for carrying out these developments must rest primarily in the governments of the countries getting the oil revenues. But there are many things also that oil companies can do by collaboration on special development projects. Aramco has done pioneering work in this regard in Saudi Arabia and has given a glimpse of what can be done. Also there are many things that your government can do, by advice and encouragement through normal diplomatic contacts and by special Point 4 projects of technical assistance and cooperation.

These are the main principles which guide us in our appraisal of the constantly shifting oil situation in the Middle East.

In conclusion let me stress that the oil problem is part of a larger problem. I have talked to you today as oil men and we have focussed attention principally on the oil problem. But the larger issue in which the oil problem is set is the whole broad question of the free world's increasing needs for raw materials—the question of the interdependence, within the community of free nations, between the industrialized countries of the West and the economically underdeveloped areas where such significant quantities of raw material resources are. * * *

PETROLEUM PROFILE

WILLIAM LAUGHLIN MCLAINE, retired vice president of General Petroleum Corporation, was the originator of a number of devices that have been important in the evolution of drilling and production techniques. Among them are a float shoe for guiding and cementing casing, a blowout preventer, a casing head, a drill pipe protector, and a combination type blowout preventor that is effective whether the drill pipe is in or out of the hole.

Widely known to the oil men of the Pacific Coast, McLaine was born in Volcano, California, of Scottish ancestry. He attended school in Amador County, California, St. Matthew's Military Academy at San Mateo, and finally Stanford University, at Palo Alto. His college career was a colorful one, in which he found himself associated with such people as the future president of the United States, Herbert Hoover; Ray Lyman Wilbur, a brilliant scholar, one day to be president of the university, and secretary of the Interior in the Hoover cabinet; William Warren Orcutt, to become famed as the pioneer petroleum geologist of the West, and many other luminaries of the scientific and business world.

McLaine pitched for the Varsity baseball nine at Stanford throughout his college career, and is justly proud of the fact that in four years his team lost only one game to California—its toughest competition. In late 1946, he received a letter from Al Masters, Stanford's athletic department head, informing him that during a careful review of the school's sports record, the McLaine baseball achievement had been uncovered. In recognition of his outstanding performance, he was awarded the Stanford blanket with block S and four stars.

McLaine left college in 1897, staying on a year after graduation, and in 1902 joined John Martin and Company, a firm of electrical contractors and engineers, as draftsman. In 1904 he was employed by Captain John Mattson, John Barneson, and others to help in the construction of a pipe line from the then booming field of Coalinga to the water front at Monterey. The line is still in operation.

In 1905 a group of San Francisco and British capitalists banded themselves together into the California Petroleum Refineries, Limited, for the purpose of producing, refining, and marketing the crude that was making Santa Maria famous, and McLaine was given the job of building a refinery on San Luis Bay. A pipe line from the field, incidental storage facilities, and the refinery itself were completed, and all was in readiness for the first run of crude when the great earthquake of April 18, 1906, occurred. The refinery was left with insufficient crude on which to operate, and in a comparatively short time, General Petroleum Refineries, Ltd., folded up.

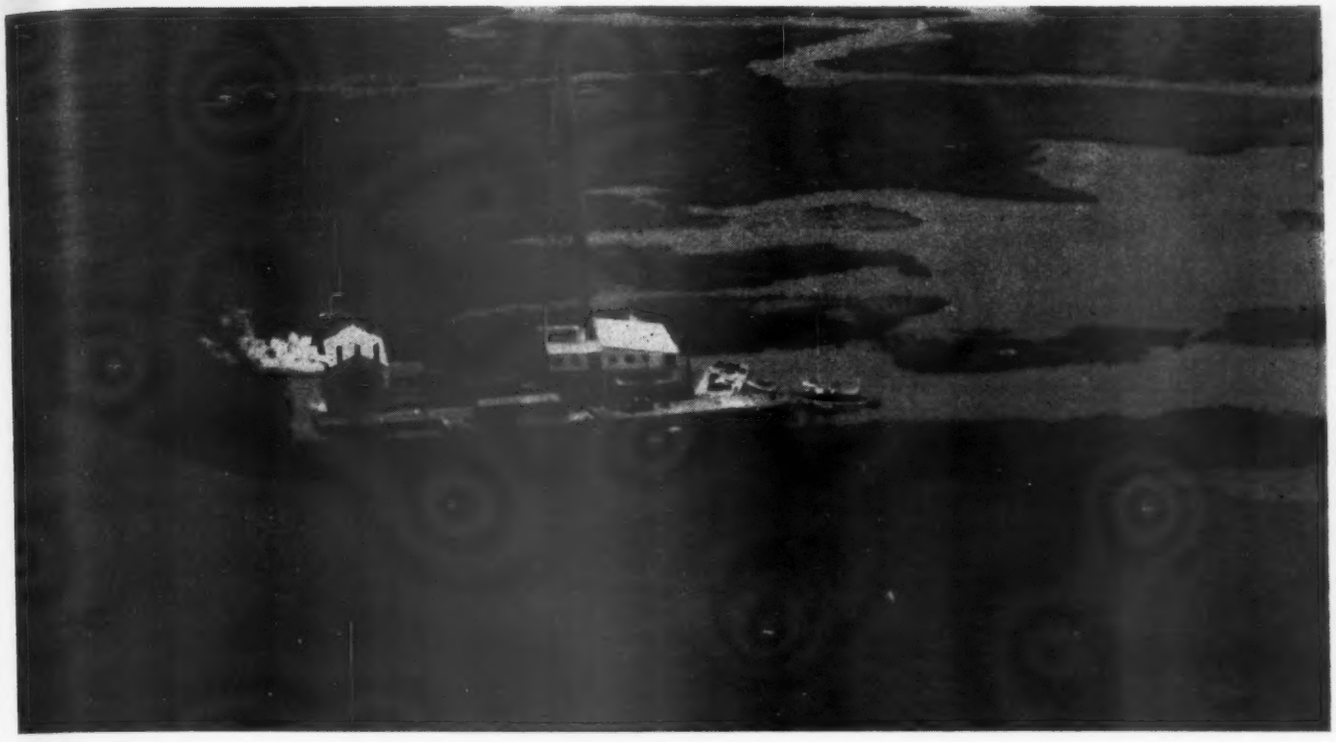
WILLIAM LAUGHLIN MCLAINE
Retired Vice President
General Petroleum Corporation

Courtesy Petroleum Production Pioneers.

In June of 1906 he joined Associated Pipe Line Company and in 1911 was promoted to manager with headquarters to be in San Francisco. He accepted an offer from Universal Oil Company instead, to become manager of field operations for the company. He left Universal in 1914, and joined Lost Hills Development Company, a new organization. The properties of this company were adjacent to those of Universal, and with the skillful use of a single string of cable tools, McLaine had quickly developed a daily yield of approximately 4000 bbl. about which time the company was purchased by General Petroleum Corporation.

Felix Chapplett, Sr., vice president of G-P, and director of production asked McLaine to join his company, which he did, becoming president of the General Petroleum Corporation of Wyoming the same year, 1917. He stayed in Wyoming developing company interests until 1921 when Chapplett became ill. At that time he took over the Chapplett responsibilities temporarily and upon his death became director of production and later was elected vice president.

In retirement, McLaine now tackles his hobbies as zealously as in other days he performed his executive duties. One of his favorites is color photography, at which he is more than usually adept. Another interest is which he finds keen enjoyment is the Petroleum Production Pioneers, of which he was fourth honorary president. He is convinced that pioneer California oil men have played an important role in the industrial development of the state, and feels the story of this contribution should become a matter of complete record.



P 425.218.4

Drilling operations from a barge in Louisiana.

GOOD MUD CONTROL SAVES PIPE

With the present pipe shortage in the drilling industry, good mud control is an important factor in achieving good hole conditions

H. I. BUSSA, F. B. VICK

THE present threatening world situation has created another serious pipe shortage in the petroleum industry. During these times a well is rarely spudded unless sufficient casing has been obtained to complete the well in the event it proves productive. Most operators are very reluctant to set a protection or intermediate string of casing in a well if it seems possible that the drilling objective can be reached without setting protective casing. Thus it is apparent that good mud control is of prime importance where long sections of open hole must withstand the adverse conditions of temperature, pressure, lost circulation, testing, electric logging, numerous trips with the drill pipe, etc.

A number of wells have been drilled to considerable depths without setting an intermediate string of casing. One well in the Lower Rio Grande Valley drilled over 10,000 ft of open hole below surface casing; another in the Upper Texas Gulf Coast and one in the South Louisiana drilled to 12,500 ft with only 2400 ft of surface casing. It would have been impossible to drill these and other deep wells without the good hole conditions assured by good mud control and drilling practices.

Increasing emphasis on good drilling mud control has led to the development of specially prepared muds to overcome particular drilling hazards. These specially prepared muds are designed to provide maximum protection to the well bore and to allow a minimum of damage to the formations exposed by the bore hole. One of these special muds and several improved techniques will be discussed below.

Oil Emulsion Mud

The speed with which a hole is drilled is important as the operator is more likely to obtain a successful completion of a well if the uncased hole is exposed to the hazards of drilling for a minimum period of time. Faster well drilling and completion means less cost to the operator and more profit for the drilling contractor. Oil emulsion muds are playing a big part in speeding up well drilling completion. The versatility of emulsion muds has contributed to the quick acceptance of a "new mud" by field personnel. Actually, emulsion muds are far from new to the oil industry but the development of an emulsion mud having stability under a wide range of applications has resulted in rapid expansion of the use of such muds. These emulsion muds have been used in all areas in which the operators desired the best mud available. The emulsion mud can be made from any water base mud by adding caustic soda, an organic emulsifier and either crude or diesel fuel oil. The characteristics of the emulsion mud are excellent lubrication properties, stability even under high pressures and temperatures of deep wells; good resistance to contaminants, low filter loss; easily controlled weight, viscosity and gels; and easy maintenance. One important fact being established by the widespread use of much emulsion muds in that their cost is only slightly higher

EXCLUSIVE

than that of comparable muds without emulsified oil.

Numerous wells have been drilled with emulsion muds for various reasons. Faster drilling time and well completion, as a result of using an emulsion mud, was demonstrated recently in a field in North Louisiana. A typical mud program for an 8100 ft well in this field consists of drilling the massive anhydrite with water, displacing the anhydrite contaminated mud with mud from the reserve pit (mud made while drilling from surface to the top of the anhydrite stringer) and conditioning this mud to desired specifications.

In an attempt to reduce the total time required to drill and complete a well the operator decided to use an emulsion mud. After drilling the massive anhydrite with water and displacing this with mud from the reserve pit, an emulsion mud was prepared by treating the mud from the reserve pit with caustic-soda, Carbonox soda ash, and diesel fuel oil. The emulsion mud was maintained from the conversion depth (approximately 4750 ft to total depth by hourly additions of caustic-soda, Carbonox, Tannex, and soda ash, with periodic additions of diesel fuel as necessary to maintain the oil content approximately 10 per cent by volume. The same mud program (oil emulsion) was followed on a subsequent well in order to obtain a more thorough comparison.

Drilling time curves and bit records showed that the two wells drilled with emulsion mud required fewer days to reach total depth and used fewer bits. Completion time was reduced approximately 50 per cent. The following data were taken from the above mentioned records:

	Type mud	Bits used	Days to TD	Total days on well
Well A.....	Water-gel	53	51	62
Well B.....	Oil emulsion	50	47*	60**
Well C.....	Oil emulsion	44	41	46

* Excluding 7 days fishing time.
** Includes 7 days fishing time.

Well "A" was drilled with a water-bentonite mud treated with caustic soda, quebracho, and barium carbonate. The total time spent on this well (62 days) was less than that of any other well drilled in the field with comparable mud. Well "B", the first well on which an emulsion mud was used, had four days less drilling time than Well "A" and total time on the well was less by two days. Well "C" the second oil emulsion job, reached total depth 10 days faster than Well "A", and total days on the well was less by 16 days. This amounts to approximately a 25 per cent reduction in the time required to drill and complete. In addition, the number of bits used to drill Well "C" was reduced by 17 per cent over Well "A".

Early Diagnosis of High Pressure Salt Water Flows

The possibility of blowouts due to salt water flows and high pressure gas in some areas is great and constant vigilance must be maintained to prevent such occurrences that may result in stuck drill pipe or complete loss of the hole. Loss of the hole may not only result in loss of the drill pipe but also loss of surface and intermediate or protection casing. Many salt water flows and high pressure gas flows give warning before the well actually starts kicking.

Many drilling wells encounter formations containing salt water under abnormally high pressure. If the mud weight at the time these formations are penetrated is not sufficient to overcome these pressures the salt water along with any gas or oil present will flow into the bored hole. If the formations have low permeability, such as shales or tight sands the quantity of invading fluids will be relatively small. If the formations have high permeability, the quantity of invading fluids will be relatively large and may result in blowouts.

In many instances the salt which is entrained in the mud system is enough to detect by conventional mud testing. The invading salt water will result in a steadily increasing amount of chlorides in the mud filtrate and if gas is present the gas will cut the mud weight and may be of sufficient volume to be detected visually. Gas cut mud, especially on wildcats, should be checked for chlorides, and if any increase is noted, frequent subsequent checks should be made to determine the trend in chloride concentration. If the trend is upward the operator should consider this a warning that the hydrostatic head of the mud column is insufficient to prevent continuous invasion of the formation fluids into the mud stream. Gas cut mud in itself is a warning that mud weight is at or near a critically low point. After the first evidence of increasing pressure and chlorides is given the frequency of mud checks becomes very important. In some instances there may be little or no gas associated with the water so that regular filtrate analysis becomes necessary for detecting chloride increases. Prevention of serious trouble consists of increasing the mud weight sufficiently to overcome the formation pressure. Chlorides in drilling mud may show appreciable increases when drilling thick salt water sands and some shale bodies. These increases should be looked upon with suspicion until it is shown that they are not associated with abnormal pressures. In some areas rock salt stringers will cause mud chloride increases but the presence of such stringers is usually known.

If rock salt is drilled the chlorides in the filtrate will increase but the cause of these increases may be determined by the following characteristic behavior of the mud. Drilling of the rock salt does not result in increased mud volume or decreased mud weight. The mud does not show gas cutting although it may air cut in the surface system if the gels and viscosity become high due to the salt contamination. The mud will not continue to flow from the well when the pumps are stopped. Occasionally salt crystals can be found in the mud.

The gels and viscosity of many muds are greatly increased upon appreciable contamination with sodium chloride. Any unusual increases in these characteristics should be cause for determining the chloride concentration of the mud filtrate. Subsequent testing will then establish the trend. Even if there is no danger of a blowout, the determination of chloride content will aid in prescribing the type and quantity of additives with which to treat the mud.

It can be seen from the above remarks that filtrate analysis supplies valuable diagnostic information, but tests made only upon mud suspected of being recently contaminated do not supply complete information unless the data from previous tests are available for comparison. Therefore, regular complete mud testing should be done where there is the slightest possibility of later trouble.

Blowouts: Causes and Comments

Blowouts are the result of insufficient hydrostatic pressure to control formation pressures and are evidenced by the uncontrolled flow of gas and fluids from the well. Insufficient hydrostatic pressure is the result of one or more of the following:

1. Abnormal water dilution.
2. Encountering abnormal formation pressures with a drilling fluid having too low a density.
3. Entraining gas in the drilling fluid.
4. Swabbing part of the drilling fluid from the hole while withdrawing the drill pipe.
5. Neglecting to keep the hole full while withdrawing the drill pipe.
6. Loss of circulation which results in reduction of the hydrostatic head by reduction of the height of the mud column in the hole.

In the case of water dilution, abnor-

The Authors

H. I. Bussa is division field service engineer for Baroid Sales Division, National Lead Company. A graduate of Rice Institute, 1937, Bussa spent three years doing production work in oil fields near Corpus Christi and Refugio, Texas. In 1940 he joined Champion Paper and Fibre Company as a chemist. Six years later he joined Baroid as a chemist in the Houston laboratory. After seven months in the laboratory, he transferred to the field as a service engineer, becoming assistant division field service engineer in the Gulf Coast division in 1948. He was promoted to his present position in 1949.

F. B. Vick, assistant division field service engineer in the Gulf Coast division for Baroid, is a petroleum engineer graduate of Louisiana State University. Following his graduation in 1943 he entered the U. S. Navy. He was discharged in 1946 and joined Baroid that year as a chemist. He became assistant division field service engineer in 1949.

mal formation pressures, or gas cutting, the hydrostatic pressure may be controlled by the addition of barites to increase the density of the drilling fluid. Good drilling practice will minimize the possibility of swabbing a hole with a "balled up bit" or not keeping the hole full. Loss of circulation may require the aid of blowout preventer equipment until the loss can be cured.

Blowouts usually cause an enormous amount of damage to natural reserves and other property. Where a well has become uncontrollable and a blowout exists it is not uncommon for the earth around the well to open up or "crater" and an entire drilling rig with its adjacent equipment disappear into the deep and turbulent hole created by the wild well. A blowout that has "cratered" can be overcome only by waiting for the well bore to bridge over with formation solids thus shutting off the high pressure flow, or by drilling a directional hole to intersect the original at a point several thousand feet below the surface. Actual intersection is usually accomplished by breaking down the last few feet of formation between the directional and original hole with fluid pumped under high pressure. At this point weighted drilling fluid is pumped into the blowout hole through the directional hole.

In drilling a wildcat well, the operator will have no previous experience in the area to guide him in determining the correct mud weight to maintain. The common practice followed is to maintain a mud weight in excess of that required for overcoming normal pressures and to increase this weight if evidence of increasing formation pressures is seen in the mud.

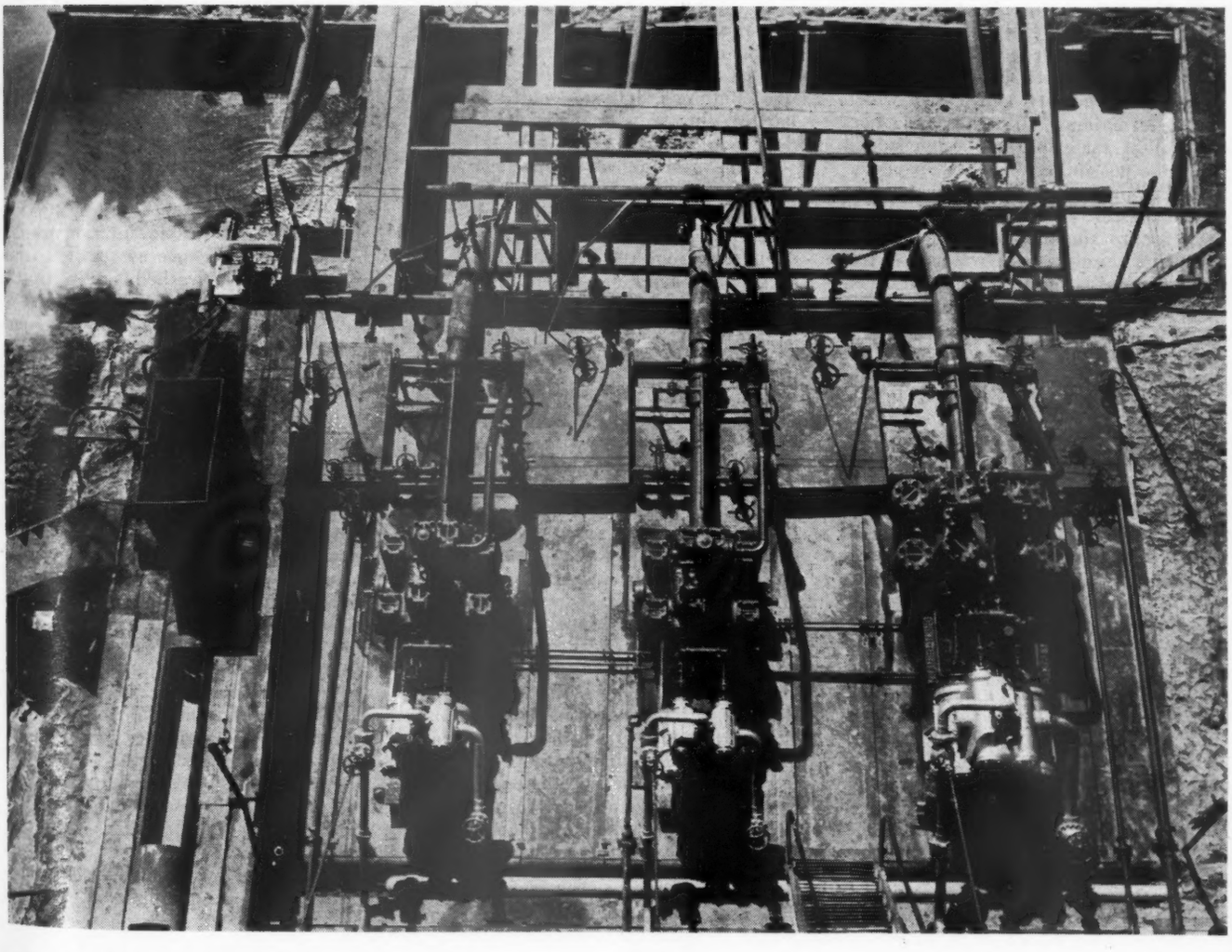
Signs that may be evidence of an increased pressure are:

1. Frothing or gas cutting of the drilling fluid.
2. Any unusual decrease in mud weight at the flowline.
3. A considerable increase in the salinity of the drilling fluid may indicate the influx of salt water under pressure or the presence of rock salt. For this reason the analysis for salt water content of the drilling fluid filtrate should be made a matter of routine in a doubtful area. The presence of rock salt, of course, does not necessarily require the addition of weight material.
4. "Heading" or "kicking" of the returning mud stream.
5. An increase in the pump rpm where steam pumps are used; or decreasing pressure where either steam or power pumps are used.
6. Sudden volume increases of the mud in the pits.

Pressure control consists of maintaining the weight of the drilling fluid so that its hydrostatic pressure exceeds formation pressures or holding the fluid in place by means of mechanical equipment. Mechanical pressure control consists of keeping the hole filled with mud; the elimination of "balled up bits" to prevent swabbing while withdrawing the drill pipe, the use of blowout preventers to confine the fluid to the hole and drilling with a closed circulating system so that back pressure can be held on the returning fluid. If the drilling fluid is gas cut but is thin enough, when it reaches the surface, to release most of the entrained gas to the open air, then riffle boards, shakers, and pit agitation will aid this release. It is extremely important that the mud pumped back into the hole does not carry entrained gas with it.

Drilling fluid additives are usually required to control formation pressures. Mud weight sufficient to control formation pressures greater than those con-

Overhead view of slush pump arrangement showing compact placing of the three pumps with ample walkway for repacking and adjustment purposes.



Texas' deep well, Humble's South Mayes Gas Unit I, No. 1 producing from 12,021-26 ft. Pumps had been removed to next location when this photo was made.

trollable by an ordinary clay-water mud can best be attained by the addition of barites. Except in emergencies the mud weight should be increased gradually to minimize the possibility of loss of circulation. Lost circulation materials can be used to assist in the prevention of lost circulation when it is necessary to increase the density above that which upper formations will withstand. Lost circulation materials are often added when the possibility of loss is suspected or where past experience indicates that loss is possible and their presence tends to minimize the amount of mud lost. Chemical thinners and water are frequently required in degassing thick-gas-cut drilling fluids. These thinners reduce the viscosity and gel strengths, thus providing a fluid mud that will readily release entrained gas to the air.

Barites Plug for Control of High Pressure and Lost Circulation

Occasionally deep high pressure wells will lose circulation and immediately attempt to blow out. Under these conditions a plug that can be removed easily is desirable. Such plugs have been successfully set by making a barites and water slurry weighing up to 22 lb per gallon (165 lb per cubic foot). This slurry is pumped through the drill pipe displacing the mud in the bottom of the hole. A solid plug is formed by the combined action of the barites settling out of the water and the loss of the water to the formation by filtration. The plug may later be washed out in the normal manner and the barites entrained in the mud has none of the undesirable effects of cement, from a cement plug.

Recently a deep well in the Upper Texas Gulf Coast encountered lost circulation and a high pressure formation caused the well to kick. Circulation had been lost intermittently for several days and upon penetrating the high pressure zone the mud started kicking over the top of the blowout preventers. The operator desired to run an electric log and set protection casing before drilling was continued. It was decided to set a barites plug to allow this work to be done with safety.

In the case above it was desired to set a 300 ft plug at the bottom of the hole. The 9⅝ in. diameter hole contained 9.3 bbl per 100 ft. The amount of barites required for a plug is 10 sacks per barrel of settled plug. Five and six tenths gallons of water per sack of barites are required to prepare a 22-lb per gallon slurry. Using the above figures a 300 ft plug would require 27.9 bbl of settled plug or 279 sacks of barites and 37.2 bbl of water resulting in 55.8 bbl of slurry (279 sacks barites have a volume of 18.6 bbl).

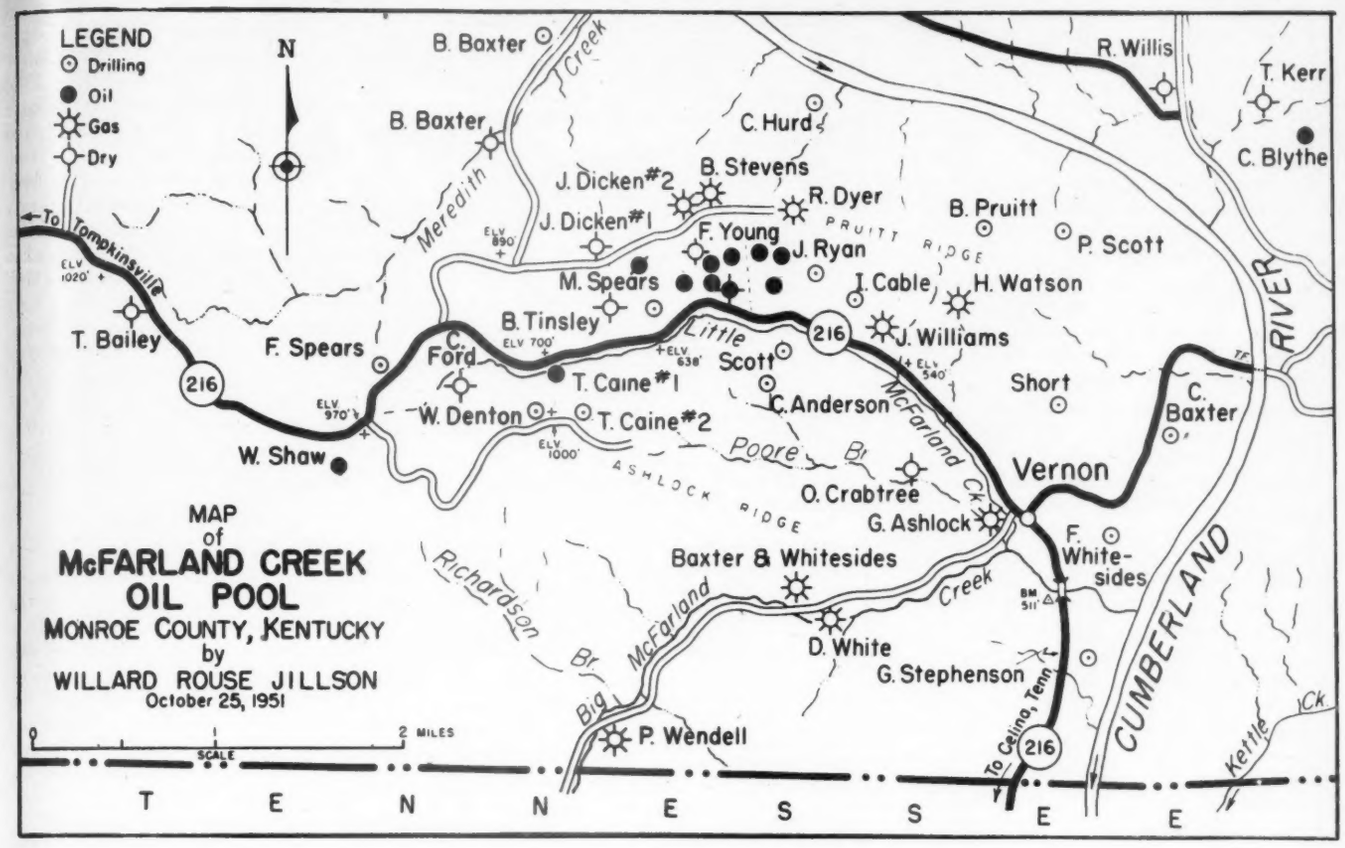
The procedure for setting a barites plug is very similar to the procedure for setting a cement plug; therefore, it is advisable to employ the services of an oil well cementing company. A cementing truck was obtained to mix the 22 lb per gallon barites-water slurry. The slurry was spotted at the bottom of the hole after which the drill pipe was pulled above the top of displacement slurry and the mud conditioned to the desired properties. The lost circulation problem and the high pressure gas flow were overcome, enabling the operator to run successfully an electric log and set 9400 ft of 7-in. casing. The mud weight was gradually increased and drilling progressed to a total depth of approximately 11,600 ft with no further trouble.

In some instances it may be desirable to modify the characteristics of the barites-water slurry to hasten the settling of the barites when the plug is spotted in the hole. Chemical mud thinners may be advantageously used in this connection. Faster, more complete settling of barites will form a denser plug to retard more effectively the high pressure gas. The low viscosity and gel strength of the slurry will allow penetration into the tiny cracks and fissures of the porous lost circulation zone. The barites upon dehydrating will tend to plug these cracks and fissures. When the gas flow or lost circulation trouble in the well bore is overcome, the barites may easily be washed out with the regular drilling fluid and bit.

With the advent of modern techniques in drilling mud control and the development of modern drilling equipment, the occurrence of serious blowouts with their accompanying loss of valuable pipe, equipment and property is being continually reduced.

As drilling continues to deeper horizons, increasing demands are being placed on the drilling mud. This is especially true in deep wells drilled without setting a protection string of pipe. In order to obtain the maximum performance of any drilling fluid, considerable thought should be given to selecting the proper type of mud for the job at hand and to the use of the new or special drilling mud techniques available for special purposes. Last but not least, close attention to the control and maintenance of good drilling fluid characteristics should be paramount in any drilling operation in order to prevent loss of scarce tubular goods as well as protecting the sizable investment every operator has in a drilling well.

* * *



A NEW KENTUCKY OIL POOL

Shallow production comes from four formations in the field with the Anderson limestone at 367-90 ft the most prolific

WILLARD ROUSE JILLSON

Gusher

On Friday, September 7, 1951, the John Ryan No. 1 well situated on the mid-waters of Little McFarland Creek in southeastern Monroe County, Kentucky, came in, flowing a gaged 400 bbl at 371 ft. Lack of adequate tankage to provide storage for so large a producer caused some temporary confusion and a small loss of oil, but in the main the emergency was promptly and properly met by the producers. Meanwhile news of the important discovery sped by word-of-mouth across the country side, and by long distance telephone to a rapidly widening circle of interest beyond the boundaries of the Commonwealth. Neighbors and others from nearby Tompkinsville, Kentucky, and Celina, Tennessee, drifted into the area on Saturday to wander at will over the Ryan lease. They watched crews of workmen set a battery of 100-bbl steel tanks near the phenomenal well that continued its flow through a 21-in. line undiminished throughout the day.

Discovery

Although the bringing in of the spectacular Ryan No. 1 gusher heralded in no uncertain manner the finding of a new and richly productive shallow oil pool in southern central Kentucky, it was not, as a matter of fact, actually the first well in the area. The discovery well, the Frank Young No. 1, had been drilled into oil producing formation on an adjoining lease sometime previously, July 26, 1951, as a gaged 15-bbl producer, by H. D. Mosier for a group consisting of O. H. Callicott of Nashville, Tennessee; Warren Wingert and P. V. Banks of Fairfield, Illinois, and A. Barton Davis of Celina, Tennessee. When the Anderson sand in this well was struck by the bit at 367 ft in depth, oil raised immediately 180 ft in the hole. It was not accompanied by water and its level could not be bailed down. This "strike" caused some local interest that steadily grew during August as two additional wells—Nos. 2 and 3—were brought in as oil producers on the Young lease and the production of this property gradually increased from 70 to 100 bbl per day.

Flowing Wild

In the meantime development by offset began on the John Ryan lease, the drilling being done by Dillard Sparks and J. Harman Overstreet of Celina, Tennessee, as part owners for themselves with A. Barton Davis of Celina, Tennessee, and Dr. Eagle Bushong of Tompkinsville, Kentucky. Two first class, steel rigs with complete equipment, casing, and one tank were moved onto the property. A little over a week after the Ryan No. 1 came in flowing—on Sep-

EXCLUSIVE

tember 16, 1951—the Ryan No. 2 came in with a roaring flood of oil. It was from the start an old time, uncontrollable gusher. Situated above No. 1 in sparse brush on an adjacent hillside, the oil horizon and total depth of this second well was 413 ft. Within a few minutes after the strike, oil rising like an ebullient fountain from the 6 in. casing, over-spread the mast head of the drilling rig and gathered like rain water during a hard shower in the declivities of the hillside, descended as rivulets and a broad sheet to a deeply cut gulley-branch some 30 ft below.

Down this channel, across the cultivated bottoms between the Ryan and Young leases the oil sped like the high rolling torrent of a flash flood, spread itself across the broad rocky channel of Little McFarland Creek and then coursed on downstream toward the nearby Cumberland River. Energetically and ceaselessly workmen on the Ryan lease, drenched to the skin by the spray and mist of the geyser-like oil, labored to close in this really spectacular well. This they finally succeeded in doing after some hours, but not before an estimated 1500 or 2000 bbl of oil flowing wild had been lost down the drainage of Little McFarland Creek. When closed in, the Ryan No. 2, with a line pressure of about 200 lb to the square inch, quickly filled all available tankage and was thus computed to be producing at the rate of 800 or 1000 bbl per 24 hours.

News of the bringing in of this truly remarkable well, which may have had an initial production, as estimated, of 2500 bbl, spread far and wide, and within a day or two a new and larger influx of oil scouts, operators, and lease men appeared in the valley of Little McFarland Creek. Joining those who had previously arrived, this group began immediately, with the purchase and assignment of leases and movement of cable tool rigs of all kinds and descriptions, the active development of the entire southern part of Monroe County, Kentucky, and some adjacent portions of the adjacent Clay County, Tennessee. As the oil men took over, bidding against each other for desirable close-in properties, the shrewd farming folk of the country side countered by dictating the terms of their leases—"fifty cents or a dollar per acre down," 30 to 60 days to begin drilling operations and occasionally, patterning after a novelty forced into the Ryan lease, a quarter instead of the usual one-eighth royalty.

Location

The new oil producing area, marked by the Young and Ryan leases, is situated 2 miles northwest of Vernon, a combination U. S. postoffice and country store seated near the juncture of Big and Little McFarland Creeks and the Cumberland River. It is about 10 miles by road southeast of Tompkinsville, Kentucky, and 7.5 miles by road slightly west of north of Celina, Tennessee. More remotely this new oil pool is 100 airline miles southeast of Louisville, and the same distance southwest of Lexington, Kentucky. In Monroe County, it lies between the formerly prolific and long-lasting Corniferous oil pools of Allen County on the West, and the world famous, gusher oil pools of Cumberland County on the East. Accordingly its producing prospect and that of the area surrounding it for 10 or 15 miles is exceptionally bright, for shallow wells properly situated as to regional and local structure.

The Author

Willard Rouse Jillson is a consulting geologist and engineer in Frankfort, Kentucky. He was state geologist and director of the Kentucky Geological Survey from 1918 to 1932, and prior to that professor of geology at the University of Kentucky. He became head of the department of geology at the Transylvania University in 1947, but resigned this year to go into oil field work more actively. Jillson has been engaged as a general consulting geologist since he completed graduate work at Yale University in 1917. He was employed by Carter Oil Company in Tulsa, Oklahoma, in 1916, and has done much work in North Texas.

Topography

The terrain of the Little McFarland Creek country is very broken. Wherever it may be entered or viewed it ranges from rolling to rough, as is characteristic of all areas in this part of Kentucky lying adjacent to the Cumberland River. Valleys are V-shaped and constricted, ridges very narrow and winding. Hill sides are steep of slope and generally stand in dense brush or second growth forest. Cultivated land, in grass or annual crops like corn and tobacco, is restricted for the most part to the narrow creek and river bottoms, though some small patches are to be found scattered along upland roads. Valley bottom elevations range from 500 to 650 ft A.T., while ridges with flat knobs and shallow gaps range from 800 to 1050 ft A.T. Local relief is usually about 200 or 250 ft; the maximum exceeds 500 ft. Taken as a whole the area may be described as a maturely dissected plateau of low elevation, dipping eastwardly and northeastwardly toward the Cumberland.

Surface Rocks

The geology of the area in and surrounding this new oil pool is relatively simple. The exposed stratigraphic section begins at upland levels varying from 900 to 1000 ft in the St. Louis (Meramec-Mississippian) limestone and extends downwardly through the Warsaw (60-75 ft), Keokuck (110-120 ft) and New Providence (150 ft) formations to the Chattanooga (Upper Devonian) black shale, which is about 20-22 ft in thickness. Beneath the Chattanooga shale, 40 to 50 ft of the Cumberland (Richmond - Upper Ordovician) sandstone is exposed in valley bottoms, creek and branch beds and channels. Contrary to the impression of not a few out-of-the-state operators now actively engaged in this area, there is no Corniferous (Middle Devonian) limestone, no Lower Devonian, and no Silurian sedimentation in this area. The contact between the top of the Cumberland sandstone and the overlying Chattanooga black shale marks a major unconformity, the missing sediments measuring all of Silurian and most of Devonian time.

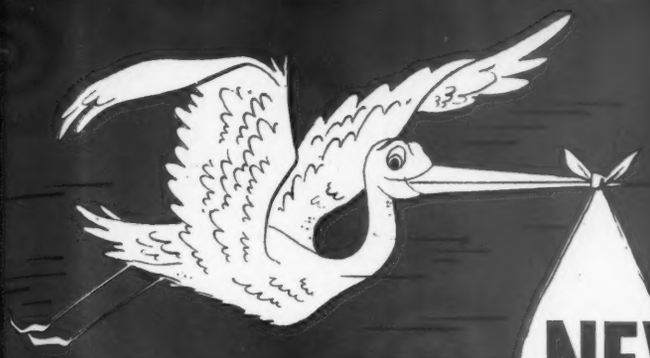
Unexposed Beds

Beneath varying exposures of the Richmond, and in a few places Upper Maysville beds, Upper and Middle Ordovician limestones continue to the base of the presently explored drilling section. In descending order the bit penetrates the local representatives of the Maysville (Leipers), Eden, Cynthiana (Catheys), and Trenton (Cannon and Hermitage) formations. Close below the latter, the driller encounters the ever-present soft, green, flocculant shale, widely known as the Pencil Cave. The best and most dependable deep key-bed in the area, this meta-bentonite exhibits a usual thickness of about 1.5 to 2 ft. The interval between the base of the Chattanooga black shale and Pencil Cave, which occurs very near the top of the Tyrone (Carters) limestone, has been measured by two wells in this field, the H. T. Cain No. 1 (694 ft total depth) and the T. W. Bailey No. 1 (955 ft A.T.), and ranges from 555 in the Cain well to 594 ft in the Bailey well. As these two, widely-known wells are not more than 2.25 airline miles apart, this variation of nearly 40 ft in subsurface interval may be taken as dependable evidence of a considerable amount of warping locally during late Middle and Upper Ordovician times.

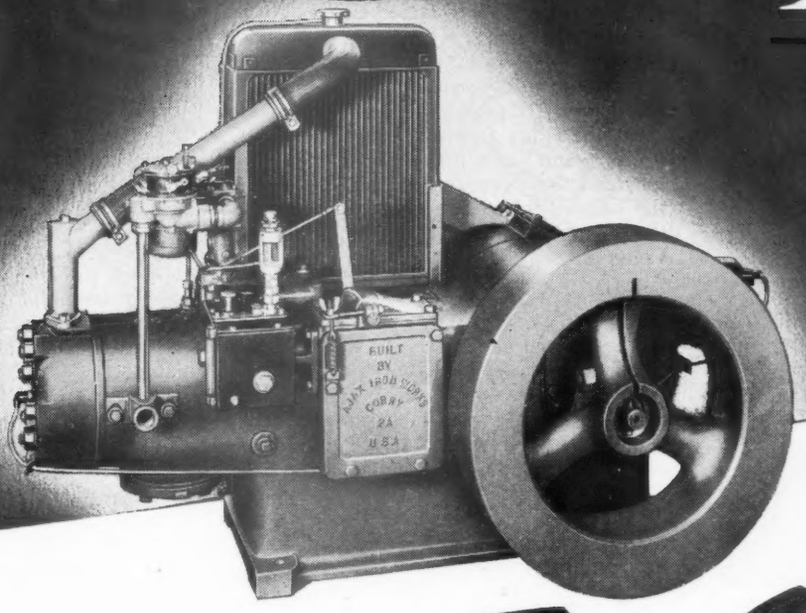
Oil Sands

Almost exactly two-thirds of the distance (367-390 ft) through this closely-watched Ordovician interval between the base of the Chattanooga shale and the Pencil Cave, occurs the Anderson "sand", a porous gray, crystalline limestone (7 to 10 ft thick), which produced the first and the maximum volume of oil on both the Young and Ryan leases. Some operators have expressed the opinion that this oil horizon is the highly regarded Granville "sand" of Clinton County—some 25 miles to the East—but coming in at 370 to 390 ft below the Chattanooga black shale it is more likely to be the widely producing Anderson or perhaps the slightly deeper Celina "sand" which has been so large a producer in certain parts of nearby Clay County, Tennessee.

Beneath this original shallow oil producing horizon in the Trenton Series,



THERE'S A GREAT **NEW BABY** at *Ajax!*



THE *Ajax* 5" x 6½" GAS ENGINE

LONG LIFE **LOW MAINTENANCE**

plus every advantage of large, medium speed types

Meet the Little Giant among gas engines—built like a big one, bulging with muscle, yet has but a tiny appetite for fuel! This is *the* engine for "start it and forget it" pumping service, where the big boys are not required. ● See the new AJAX 5" x 6½" at your nearest supply store!

AJAX ENGINES

AJAX IRON WORKS

Manufacturers of Gas Engines • Steam Drilling Engines • Industrial Steam Engines

CORRY, PENNSYLVANIA

Oil Field Distributors: THE NATIONAL SUPPLY CO., TOLEDO, O. R. B. MOORE SUPPLY CO., INC., BOLIVAR, N.Y.
BETHLEHEM SUPPLY CO., TULSA, OKLA.

Steel cable tool drilling rig on the John Ryan No. 1 well, Little McFarland Creek, Monroe County, Kentucky.

the Ryan No. 3, which came in October 19, 1951, quietly flowing and pumping a calculated 250 bbl per day, produced from a depth of 475 to 477.5 ft total depth or about 400 feet below the Chattanooga shale and therefore, appears definitely to be producing from the Celina "sand." Below the Pencil Cave, some 4 to 10 ft, the H. T. Cain No. 1 at the foot of the hill along side Little McFarland Creek, found oil in the Upper Carters and this oil horizon, though occurring rather high in this dolomitic formation, would be styled the Modoc "sand." In summation then, there appears rather definitely to be present here three* separate and distinct oil producing formations, all limestones. These are: (1) the Anderson, (2) the Celina, and (3) the Modoc. Up to the present the Anderson limestone has been the source of most of the oil produced in this new pool.

The Trenton section accounts for the upper two oil horizons, and the Carters for the third. All are embraced within the Middle Ordovician and all are oil-producing "sands" of the prolific type —definitely so recognized in this part of Southern Kentucky and the adjacent north-central portion of Tennessee. The prototypes of the flowing producers are to be found in many of the great oil wells in this part of Kentucky, particularly the shallow 190 ft, Bud Kerr No. 3, a long-to-be remembered 2000-bbl gusher drilled by James A. Gartlem for the McClintock Oil Company in 1923 in the Kettle Creek oil pool 4 miles to the East, near old Martinsburg in Monroe County. Another of the many that might be named, including the 171 ft "Old American" 50,000-bbl gusher of 1829, was the widely famed Graves No. 1 "Burning Well", which was brought in wild at 600 ft in 1901 by John McQuade for the Greensburg Petroleum Company. It produced an estimated 3000 bbl a day from the Lower Sunnybrook "sand" at a point 9 airline miles north of the Ryan and Young leases in the upper tip of the Salt Lick Bend of the Cumberland River in Cumberland County.

*During the evening of October 30, 1951, William Shaw No. 1 was reliably reported standing deep in oil at 300 ft below the Chattanooga shale. This fact points to a fourth producing oil sand in this new pool—the Granville. It also indicates an extension of the field to a point 2½ miles southwest of the Young and Ryan leases.

Structure

The new oil pool on Little McFarland Creek in Monroe County, Kentucky, is situated on the southeastern flank of a sharp and highly localized flexing of the Cincinnati Arch, a regional ge-anticline of basic oil and gas producing importance. The controlling structural feature is known as the Meridith Dome. Actually it is an anticline of significant proportions, plunging to the southwest with an elongated ovalate crest, which exhibits an apex closure of about 20 or 25 ft. The doming feature alone covers a top area of approximately one square mile at and above the 715 contour based upon the top of the Chattanooga (Upper Devonian) black shale. High locations on this very pronounced upfolded structure, which embraces in its entirety about 10 sq miles, have been drilled dry or have shown occasional pockets of gas. Oil occurs on the flank between the 640 and 660 ft contours on this regional feature, but its occurrence in commercial quantity is very apparently restricted to minor, crenulate upfolds of sharp and highly localized area.

Such, for example, is the case on the Young and Ryan leases where dips on the top of the Chattanooga black shale ranging from 3 to 5 and 6 deg define a minor anticline or ripple of structure, the axis of which is nearly exactly transverse to the main feature—the Meridith Dome of the Cincinnati Arch. Fissures and fractures at depth attending such pronounced minor folding, evidently provide the reservoiring space in the lower Trenton limestones that has produced the gushers of the type already described in this area. Specifically the Ryan lease occupies a considerable part of the long southeastern or normal dip of this small structure. The No. 2 well is the largest the field has up to this time produced, being set at the very top of the Chattanooga shale at the apex of the minor fold with a C.H.E. of 680 ft A.T. The adjoining Young lease, occupies very apparently, the short and rather flat minor reversal to the northwest. Leases in eastern Monroe County exhibiting such types of minor structure riding the flanks of major folds and wells favorably situated on them may look confidently forward, it is believed, to commercial oil production at shallow depths—365 to 415 ft.

Operations

While the discovery of oil in the Frank Young No. 1 well occurred late in July last summer, it was not until the Ryan No. 1 flowing 400 bbl flush came in early in September that active operations tending to define and extend this new pool really got underway. The writer was in the field more or less continuously during this time and is witness to the fact that at least one new portable drilling rig moved into the Little McFarland Creek valley or surrounding territory every day from September 10 to October 10, 1951, and on some days two new rigs came into this area. These rigs — principally Keystones, Cyclones and Bucyrus-Eries 22, 24, and 28 L— came from Allen and Barren Counties on the west, Cumberland, Clinton, and Wayne counties on the East in Kentucky, and Clay and Fentress counties on the south in Tennessee. More remotely some came from Ohio, Daviess, and Hancock in western Kentucky and not a few from southwestern Indiana and southern Illinois.

On September 22, 1951, 10 rigs were drilling in the valley of Little McFarland Creek and 7 more were active on the adjoining ridges and branches. On October 11, 1951, the writer made a count of the rigs actually drilling in the eastern part of Monroe County, and found that within five miles of the Young and Ryan leases the number was 34. Perhaps at no time since the exceptional LaGrande oil pool was drilled in Hart County during the period 1930-1931 have so many exploratory drilling operations been confined to so restricted an area—less than 5 sq miles—as is now to be found in this field on and adjoining Little McFarland Creek.

At the present writing, as the accompanying map clearly indicates, the original oil producing area is essentially defined by dry holes and gas wells. Ten wells are in daily production of oil. Although a few close-in wells are still being drilled, the trend now is definitely away, to newly chosen locations sometimes 5, 10, and 15 miles removed from actual production. Producers are admittedly making a serious effort to discover elsewhere in Monroe County at shallow depths one or more new oil pools with properties as productive and as easily operated as the Young and Ryan leases on Little McFarland Creek, from which to date about 15,000 bbl of oil have been produced, tanked, trucked, and sold. The principal purchaser, at $2.50 a barrel, has been the Somerset Refinery at Somerset, Kentucky, owned and operated by Sam D. Jarvis of Decatur, Illinois, and Evansville, Indiana.

* * *

—up to 50 HP

...now available in new, larger "OILWELL"-LORAIN ENGINES

Gas or Diesel Single Cylinder Slow Speed

Model "A" 13″ x 13″ Gas or Diesel Engine
. . . with operating range from 32.2 HP at 185 rpm to 50 HP at 300 rpm

Model "R" 12″ x 13″ Gas Engine
. . . with operating range from 27.4 HP at 185 rpm to 40 HP at 300 rpm

The "True Story" of Lorain Engine No. 100

On November 9, 1946, this Model "L" Lorain Gas Engine was placed in service near Reed City, Michigan; where it remained until June 20, 1951 when it was re-installed on another well.

It was driving an "Oilwell" TC-23 Pumping Unit which produced approximately 300 bbls. of brine water and 5 bbls. of oil per day . . . pumping a 3600′ well, equipped with 2¼″ subsurface pump in 2½″ tubing. The engine operated continuously at approximately 485 rpm and the pumping unit was set for 54″ stroke lengths at 19 strokes per minute.

At the time of relocation this engine had been operating 24 hours per day since its installation over 4½ years ago with only approximately 3 days shut-down time—or a net total of 1682 operating days.

THE MAINTENANCE RECORD FOR THIS ENGINE FOR THE ABOVE PERIOD IS:

May 31, 1948—5 Piston Rings and 1 Cylinder Head Gasket

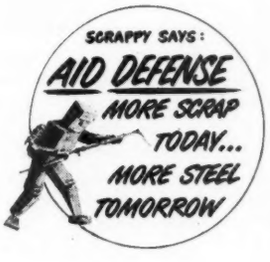
November 13, 1948—1 Radiator Core

April 25, 1950—5 Piston Rings, 1 Cylinder Head Gasket and 1 Connecting Rod Bearing.

These new models

. . . extend the line of "Oilwell"-Lorain Engines to include four sizes in Gas Engines and three sizes in Diesels . . . providing an over-all horsepower range from 10.7 to 50 under continuous operating conditions.

If you are interested in gas or diesel prime movers within this performance range . . . ask your "Oilwell" Representative for Engine Booklet No. 16-51 and . . . GET THE FACTS ON "OILWELL"-LORAIN OILFIELD ENGINES.



OIL WELL SUPPLY COMPANY

Branches Serving All Oil Fields

Executive Office — DALLAS, TEXAS
Export Division Office —
30 ROCKEFELLER PLAZA
NEW YORK 20, N. Y.

Division Offices — CASPER, WYOMING
COLUMBUS, OHIO . . . DALLAS, TEXAS
HOUSTON, TEXAS . . . TULSA, OKLAHOMA
LOS ANGELES, CALIFORNIA

USS TRADE MARK

"OILWELL" TRADE MARK

UNITED STATES STEEL

CROOKED HOLES†

As oil wells are drilled deeper and faster, the problem of crooked holes becomes more expensive and more significant to operators

BRUNO SCHABARUM*

Abstract

While crooked holes have been with the drilling industry for many years, the author says they were not much of a problem in the Permian Basin of West Texas prior to 1945. He points to the use of drilling weights prior to that time of about 15,000 lb on 8¾-in. bits and about 12,000 lb on 6¾-in. bits, as compared to between 40,000 and 60,000 lb on the larger bits and from 20,000 to 40,000 lb on the smaller bits, today. He says that these additional weights are being obtained by running drill collars and that even though they are stiffer than the pipe, the formation still exerts a sufficient reaction to cause the hole to deviate in some cases. Other factors contributing to crooked holes, and method for correcting hole deviation, are discussed.

Because the author feels that as oil wells are drilled deeper and faster, the problem of crooked holes will become more expensive and more significant, he urges study of the problem by the industry. He suggests formation of a committee to be sponsored by AAODC and to be composed of representatives of drilling firms and oil operators.

THE term "crooked holes" is a rather loose definition of the problem that we are to discuss. In the drilling industry a hole is crooked if the slope of the hole is away from the vertical by 3, 4, or 5 deg depending upon the limits set by the operating company.

Historically, crooked holes have been with the drilling industry for many years. In the Seminole, Oklahoma, boom, several stories are told of one contractor running into a hole being drilled by another. During those times one or two drill collars were used, but bit weight was secured by running the 6⅝-in. drill pipe in compression. It is conceivable that this contributed materially to the crooked hole problem. In those days instruments to measure the angle of inclination of the hole were not used.

In regard to the Permian Basin of West Texas, crooked holes were not much of a problem prior to 1945. In those days the drilling weights on 8¾-in. bits were about 15,000 lb, and about 12,000 lb on 6¾-in. bits. When it was learned that much faster rates of penetration could be obtained by increasing bit weights, the problem of the hole working away from the vertical became more important.

Today, most contractors are running from 40,000 to 60,000 lb on 8¾-in. bits and from 20,000 to 40,000 lb on 6¾-in. bits. These additional bit weights are being obtained by running drill collars, and even though the collars are stiffer than the pipe, the formation still exerts a sufficient reaction to cause the hole to deviate in some cases.

Another factor that has aggravated the problem is that as the wells become deeper, formations below the massive Permian limes and dolomites are penetrated. Some of these formations are shales, others are layers of limestones and sands and cherts. It is well recognized that changes of formation are conducive to making the bore hole travel away from the vertical.

As the wells become deeper, the rock also assumes greater physical strength and it is well known that the drillability of the rock decreases as the strength increases. It therefore requires greater bit weight to penetrate these extremely hard rocks. Any fracture or voids that may be at an angle will decrease the reaction in that direction and the hole will deviate in the same direction.

The speed of rotation also seems to have some influence on crooked holes. As bit weights have increased, it has been found advisable to decrease rotating speeds so as to secure satisfactory bearing life of the bearings in the cones. Slower bit speeds seem to be conducive to hole deviation.

It may be said that any factors that decrease drilling rates such as high viscosity or low water loss of the drilling fluid are conducive to crooked holes. This statement is made because we cannot recall one instance where a crooked hole was experienced while drilling with water.

Crooked Holes

It is obvious that it is easier and less hazardous to keep a hole straight than to straighten one after it has gone crooked. The best means of doing this is to use drill collars of as large a diameter as the hole and fortitude of the operator will permit. Arthur Lubinski of the Stanolind Oil and Gas Company research department has recently pointed out the above by theoretical treatment of the problem. He shows that a 6¼-in. diameter drill collar string will buckle when the bit weight exceeds 8500 while an 8-in. diameter drill collar string will require 16,300 lb before it buckles. These figures apply when using both strings in 9 in. holes. In 8¾ in. holes, this condition should be some better.

About three years ago, our company began to use larger collars in holes that tended to go off the vertical. Today we use 8-in. collars in 8¾-in. hole; 7-in. collars in 7⅞-in. holes, and 6¼-in. collars in 6¾-in. holes. Generally, only 5 or 6 large collars are used at the bottom of the string and the rest are reduced in diameter. Although this practice seems to help, it is not a definite cure-all for the problem.

Our company has also resorted to a bladed stabilizer above the bit. The tool is 10 ft long and the blades are wide with a diameter across blades of 8⅝ in. for the tool to be used in 8¾-in. hole. The 7⅞-in. hole tool is 7¾ in. OD and the 6¾-in. hole tool is 6⅝ in. OD. This stabilizer is run immediately above the bit. Some thought has been given to running two stabilizers, one immediately above the bit and the other on top of the lowest collar. This scheme may have merit as the guided section will be considerably longer than at present.

Keeping the rotary speed up to at least 80 RPM will also help keep the hole closer to vertical.

After a hole has gone to the limit of deviation allowed, then the problem of straightening is present. The first though is to hold up the weight and spin the rotary up to 110 to 120 RPM. It is natural to assume that this practice will straighten the hole because this is the way we used to normally drill a few years ago. But it is also true that the rate of penetration falls way off and if the bit does not make hole, then the deviation cannot be decreased.

Setting an oriented whipstock at the

†Presented at eleventh annual meeting, AAODC, Fort Worth, September 24-25, 1951.

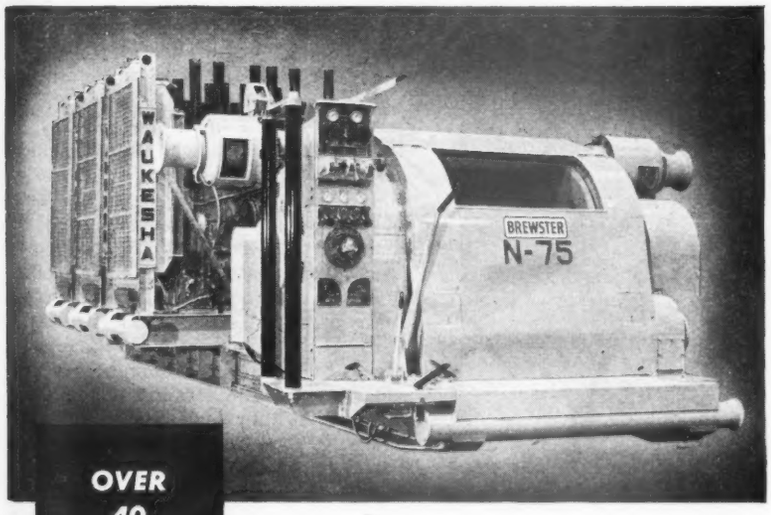
*General manager, Carl B. King Drilling Company, Midland, Texas.

"Our New Brewster N-75 Is what we've been Looking for"

Frank Garret,
Drilling Superintendent

Frank Garrett, drilling superintendent and Tommy Reynolds, tool pusher, Cactus Drilling Company, are on the second well with their new Brewster N-75 drawworks.

They say that it is the rig they have been looking for—one that will drill to 10,000 feet and still make hole as fast and operate as smoothly as their Brewster N-7.



Tommy Reynolds
Toolpusher

OVER 40 YEARS EXPERIENCE

Brewster's new N-75 drawworks is the rig you are looking for. You'll like the 700 horsepower, the larger diameter and greater length of drum core—the heavy-duty chains on high and low drum drives—the auxiliary positive clutch which is built into the low drum friction clutch.

You'll find that the N-75 can take a lot of hard use and will give you years of low cost drilling.

Let us tell you about the new N-75.

Write today for the new Brewster catalog, giving full details on Brewster Drilling Equipment, Drawworks, Blocks, Swivels and Rotaries.

SUPPLY COMPANIES

Apex Equipment Company
Bovaird Supply Company
Industrial Supply Company
Murray Brooks, Inc.
Reams Supply Company

In Canada: Rocky Mountain Supply Co. Direct and through recognized export dealers.

Manufacturers of Fine Drilling Equipment ... Since 1916

BREWSTER DRILLING EQUIPMENT

THE BREWSTER COMPANY, INC., SHREVEPORT, LA.

bottom of the hole and kicking the hole back also has its possibilities. Sometimes, however, the whipstock turns and the hole is in much worse shape than it was originally.

All of the above have various modifications.

We have observed numerous cases where the deviation has exceeded the figure set by the contract but the contractor was allowed to continue to drill for the reason that it was felt that there was no practical way of producing a hole whose deviation was less than that required by the contract. Further, there is considerable question that a simple deviation test means very much in practical production practice.

In thinking of the deviation clause in a contract it is thought of as a means of limiting the horizontal drift of the bottom of the hole with respect to the top of the hole. This association is incorrect for the reason that most of the instruments in common use only measure the angle to the vertical of the tangent to that section of the hole that is being measured. It can be easily seen that a high angle of deviation may still permit the hole to bottom very close to a point directly below where the hole was started.

Another reason that has been given for specifying low deviation angles in the contract is fear of running casing and later production problems. We are all familiar with practices followed at Long Beach, Huntington Beach, and other coastal fields in California. Some of these wells deviated as much as 30 and 40 deg. No particular casing or production problems are encountered.

There is not much question but that living up to the deviation clause in the drilling contracts is one of the most serious difficulties that confront the drilling contractor. It is time that a concerted effort be made to solve this problem. The Mid-Continent district API has a study committee working on the problem. Their approach seems to be to try and devise ways of drilling straight holes. So far, they have advocated the use of larger and larger drill collars. We have complied with this practice for several years and know that it is not an absolute solution.

We would like to propose the formation of a committee sponsored by the Contractors Association and which would have as members both contractors and operating company personnel. Their first obligation would be to determine exactly the reasons for including the deviation clause in the contract, and to determine the end result desired.

After the above has been determined, then means of accomplishing this result could be devised.

We think that this procedure is highly desirable because it is felt that the deviation clause in a contract is indefinite and does not necessarily secure the results required; further, in attempting to comply with the clause, great expense is forced upon the industry. To substantiate and indicate the thinking of some of the producing companies, we would like to report that one large operating company has removed the deviation angle entirely from their contract. Their contractors still run straight hole surveys and efforts are still made to keep the holes reasonably straight.

Three large operating companies in the Permian Basin, although they have not removed the straight hole clause, advise that they have liberalized it because they realize that it is practically impossible to stay within the limits commonly accepted in the past in certain areas. One of these companies requests that the rate of change of deviation be confined to 1 deg or less per 100 ft of hole is possible.

Another operating company has made it a practice to run a direction survey of the hole whenever it seems crooked. If the survey indicates that the bottom of the hole is in a cone of a given size whose vertical axis passes through the center of the location and if the rate of change of slope is not too great then they permit the contractor to continue drilling even though the slope test is considerably above the upper limit specified in the contract.

It is our opinion that as we drill deeper and faster this problem will become more expensive and more significant. It is therefore earnestly suggested that some action be taken on this matter by the industry in the immediate future. * * *

If you want extra long, extra productive service life from the oil field equipment you build or buy, make sure Aetna Bearings are on the job. Aetna Bearings are products of the most modern facilities : . . and of technical skill unsurpassed in the industry. They are especially engineered to meet the high load capacity, high reserve stamina and 'round-the-clock dependability required in the most rugged oil field applications.

Write for complete information . . . TODAY!

AETNA BALL AND ROLLER BEARING COMPANY
4600 SCHUBERT AVENUE • CHICAGO 39, ILLINOIS

Aetna

Standard and Special Ball Thrust Bearings . . . Angular Contact Ball Bearings . . . Special Roller Bearings . . . Ball Retainers . . . Hardened and Ground Washers . . . Sleeves . . . Bushings . . . Miscellaneous Precision Parts.

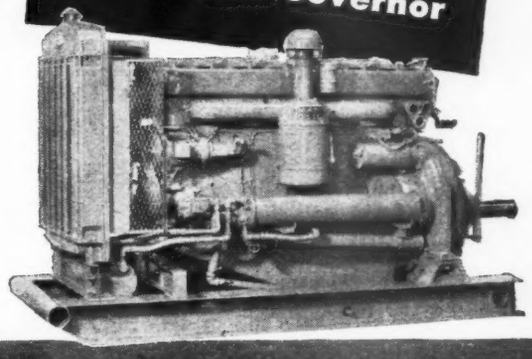
MURPHY DIESEL'S *Quick responsiveness pays off* when making hole

and here's why

the Murphy Hydraulic Servo-Type Governor

ONE of the most important characteristics of a really good drilling engine is its ability to take hold of a load and hold on without missing a beat . . . and that's just the characteristic of Murphy Diesels that so many drillers praise. Grant Hill, a driller on the Murphy powered Merline Drilling Company rig illustrated above says these Murphy Diesels are the most responsive power he's ever operated.

Murphy's quick responsiveness to load changes is the result of an integral hydraulic servo-type governor and other design features all of which are described in the informative booklet *"10 Questions to Ask a Diesel Engine Salesman"*. Ask your Murphy Diesel Dealer for a copy or write direct.



MURPHY DIESEL COMPANY
5343 W. Burnham St.
Milwaukee 14, Wisconsin

OIL INDUSTRY FACTORY BRANCH
Sales, Parts and Service:
113-117 South Elwood Street, Tulsa, Oklahoma

MURPHY DIESEL

***Heavy duty power* for the oilfields**

Murphy Diesel Engines and Power Units for drilling and pipe line pumping, 90 to 226 H.P., 1200 and 1400 RPM. Generator Sets, 60 to 140 K.W. Dual-Fuel Engines, 135 to 180 H.P. Also Crude Oil Burning Engines.

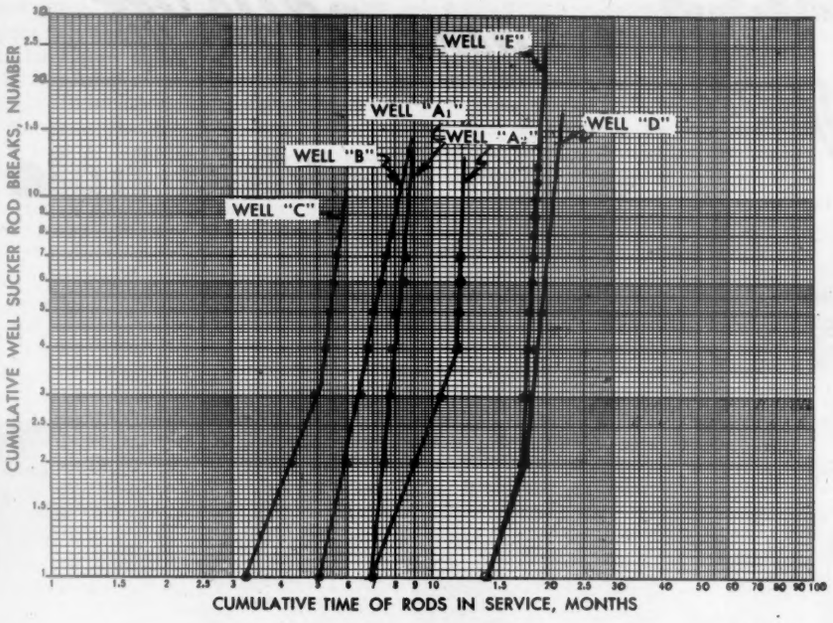
See Your Murphy Diesel Dealer

LOS ANGELES, CALIFORNIA
Engine Sales & Service
SAN ANTONIO, TEXAS
J. E. Ingram Equipment Co.
EVANSVILLE, INDIANA
Pershing Equipment Co.

EDMONTON, ALBERTA, CANADA
Northern Engine & Equip. Co., Ltd.
MT. VERNON, ILLINOIS
Ed Meyer Tractor Co.

AMARILLO, TEXAS
Service & Supply
GREAT BEND, KANSAS
Manufacturers Dist. Co.
JACKSON, MICHIGAN
Utility & Industrial Supply

DALLAS AND LUBBOCK, TEXAS
Conley-Lott-Nichols Mach. Co.
HOUSTON, TEXAS
Houston Engine & Pump Co., Inc.
ODESSA, TEXAS
Electric Service & Supply Co.



Well	Depth, ft	Plunger, in.	Stroke, in.	Speed	Rod-type steel
A_1	7820	1¾	240	6.8	Special
A_2	7820	1¾	240	6.8	3310
B	7680	1¾	240	6.5	Special
C	4500	2½	72	14.0	4621
D	7710	1¾	240	6.2	Special
E	6540	1¾	120	12.5	3310

FIG. 1. Frequency of oil well sucker rod breaks.

Graphical Method of Evaluating Performance of Oil Well Sucker Rods

J. P. PEDRETTI

Abstract

Failures of oil well sucker rods under corrosion fatigue follow a straight line relation on log-log paper where the cumulative rod breaks are plotted against the time the sucker rod string has been in service continuously in the well, provided there have been no major changes in rod stresses and number of stress reversals.

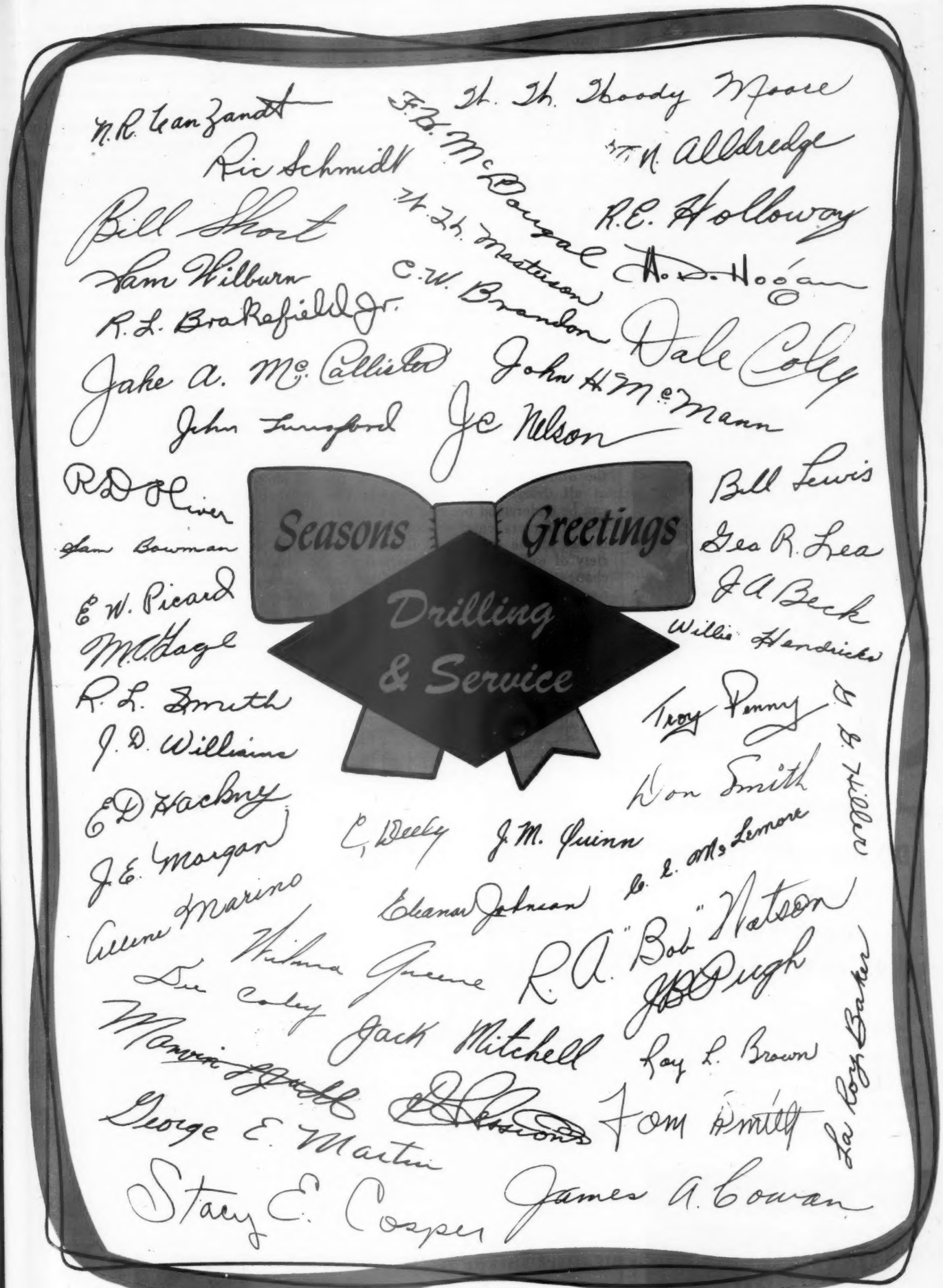
THE important part that oil well sucker rods play in the production of oil is well known, but a simple method is needed whereby the operator may understand the function, problems, and economy of sucker rods. As there is a variety of commercial sucker rods by make and type used in the Santa Fe Springs field by the Union Oil Company under severe conditions of well loading, accompanied by metal corrosion, it was necessary to follow the type and frequency of failures. It was found from this observation that almost 100 per cent of the sucker rod failures in the Santa Fe Springs field were due to corrosion-fatigue. In all cases the broken rods showed evidence of a minute pit on one edge of the plane of failure surrounded by shiny semicircular marks that indicated the growth of metal failure. Sucker rod failures were more frequent in the wells pumping below 5000 ft with a production cut above 50 per cent of high salinity water operating with a maximum rod stress ranging from 27,000 to 37,000 psi. The possible causes for the stress-raisers or surface cracks on the sucker rods can be summarized as follows: Minute consecutive transversal cracks along, and in some cases opposite to, the plane of friction; pinpoint pitting produced by electrolytic cells due to metal impurities. Also, there are cases where sucker rods with certain heat-treating numbers show failure at a consistent distance from one end of the rods, possibly due to cold spots on the metal developed during heat-treating of the rods. A few cracks come from tool marks inflicted on the rod surface by careless well crew operation and failure of the rod pins due to improper shouldering of pin and coupling.

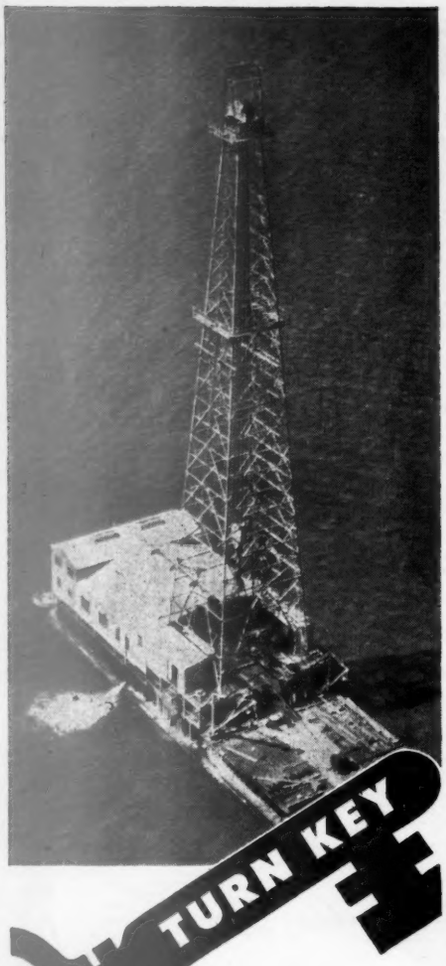
Thus, in respect to corrosion-fatigue, when any repeated stress, however small, occurs simultaneously with corrosion, it will lead to sucker rod failure after a sufficient time. It is then apparent that oil well sucker rods cannot be used indefinitely without failure. A simple method of studying the reasons for sucker rod breaks is plotting by wells on a logarithmic chart the cumulative number of rod failures against the period of months the sucker rods have been in service. A straight line relationship has been found to exist for all the wells in consideration regardless of well load, type of pumping unit used, pumping unit production speed, or difference of sucker rod make. Fig. 1 shows the straight line relationship from the first rod failure to subsequent ones, with the exception of a few wells where there is a change from the original slope of the first few rod breaks to the following ones. This characteristic can be observed in the case of Well "A" and of Wells "C", "D", and "E" in Fig 1, where the increase of the well production cut coupled with the increase of the unit speed caused the sucker rod breaks to increase. The other reason is that the initial rod breaks can begin in one size of the sucker rod string and then be followed by the other sizes, consequently

The Author

Juan P. Pedretti, petroleum engineer for Union Oil Company of California, Santa Fe Springs, California, was born in Asuncion, Paraguay, 1915. He obtained a BS in civil engineering and BS in petroleum engineering at the University of Texas. He was civil engineer for the city of Asuncion in planning its sewage system. He belongs to the American Society of Chemical Engineers, American Petroleum Institute, and American Institute of Mining and Metallurgical Engineers. He is also an honorary vice-consul of Paraguay in Austin, Texas, and received the Cruz del Chaco, highest military decoration in Paraguay, as a pilot in the Chaco War.

EXCLUSIVE


Seasons Greetings
Drilling & Service



LET
Levingston
DO THE COMPLETE JOB
with the
machinery
of your choice

From crown block to barge bottom, Levingston is prepared to accept the entire responsibility of constructing and rigging-up your submersible drill barges on a turn-key basis. You select the tools or equipment, and Levingston's experienced organization will install them for safe and efficient operation on marine locations.

Levingston
SHIPBUILDING CO.
Orange, Texas

increasing the upward slope of the line representing the rod break frequency for that particular well rod string. On the other hand, the replacement of one entire size of the sucker rod string by new sucker rods will not prevent the fatigue of the other sizes, regardless of the saving of rod failure frequency for the entire string. This is illustrated by the curve representing Well "G" in Fig. 2. A definite decrease of the line slope can be observed in this figure after the entire 7/8 in. sucker rods of the 1 in., 7/8 in., and 3/4 in. string had been replaced by new sucker rods, and the saving is represented by the area that lies between the projected dotted line and the new line of rod failures. The last part of the curve representing Well "G" in Fig. 2 shows a further saving of rod break frequency due to the reduction of pump plunger size from 1¾ to 1½ in., which caused the reduction of sucker rod stresses as pounding fluid condition was eliminated for the rest of the rod string's service.

The relative position of the curves for the different wells on the chart is not at all determinable beforehand. This can be understood because a great number of factors enter to contribute the causes of the sucker rod failures: Variety of well conditions; reservoir fluid change, especially where more than one zone contributes to the production of the field; and difference in make and type of sucker rod steel. That the two different makes of sucker rods used on Well "A" in Fig. 1 lasted exactly the same period of seven months without breaks is unusual, but the slopes of the two curves differ from each other from then on due to the different types of steel and makes of the sucker rods.

Nowadays the oil field operator in the Santa Fe Springs oil field is much concerned with the continued increase of the oil well operating cost that has to be paid from the revenue of a rapidly declining net oil production accompanied by high salinity and high water production per cent cut. The latter is the principal element contributing to the corrosion of iron on the production equipment. This new and well recognized factor has been the main cause of the rapid rate of replacing production equipment. As an answer to this sucker rod corrosion problem, many oil well tools and chemicals are in use today in the Santa Fe Springs field. For illustration of the simplicity of the log-log chart as a method for evaluating the effectiveness of a corrosion inhibitor, the sucker rod break frequency of Well "H" has been plotted in Fig. 2. It can easily be seen that at the end of the twentieth month of service in this well the sucker rod string without inhibitor should have had 25 breaks, but with the use of the corrosion inhibitor, only 10 breaks were observed, which represents a saving of 60 per cent of the total number of breaks, or 78 per cent of the breaks since the corrosion inhibitor was begun in the well. Incidentally, similar graphi-

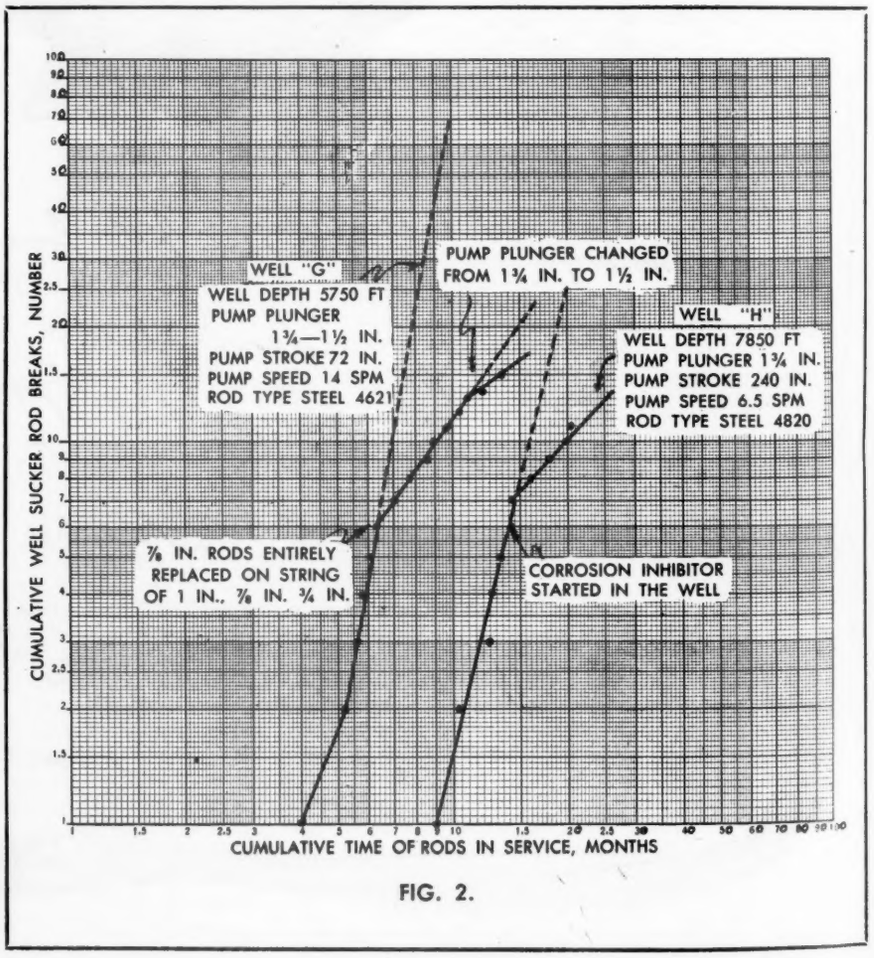
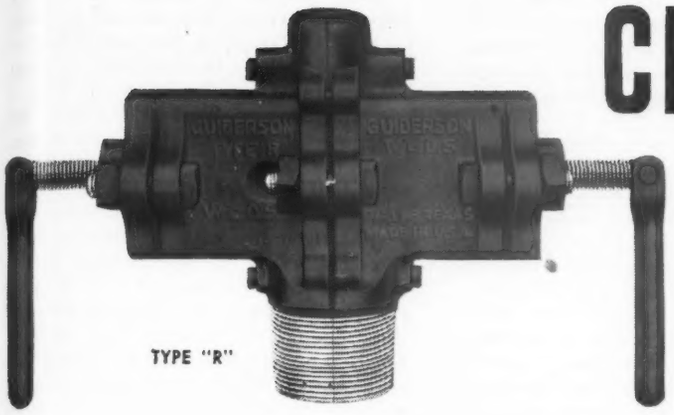


FIG. 2.

CLEAN FLOOR SAFE DERRICK



TYPE "R"

TYPE "S"

GUIBERSON
Wire Line Oil Savers

for Excellent Pack-Off—Clean, Dry Line

3 to choose from—take your choice and know that if it's Guiberson, it's *good!*

TYPE "R"—for tubing. Simple, inexpensive, effective. Split housing for easy installation.

TYPE "S"—for casing or tubing. Economical, simple—similar to "R" but heavier construction, flange bottom or tubing connection.

TYPE "D"—for tubing or casing. Two independent sets of rubbers, single end operation, make it cost more but still very economical. Pin or flange adapter connection.

Non-sparking brass bushings and guides throughout . . . long-wearing rubbers . . . finest Guiberson precision construction.

TYPE "B" RELEASING ATTACHMENT—Positive release for Oil Savers—prevents tool damage, necessity for flagging line. Easy to attach, pressure won't release it.

TYPE "D"

TYPE "B" RELEASING ATTACHMENT

Better Be Safe Than Sorry!

BETTER BE SAFE THAN SORRY GUIBERSON REG. U.S. PAT. OFF.

THE
GUIBERSON
CORPORATION

ESTABLISHED 1919 • DALLAS, TEXAS, U. S. A.

Sold By Leading Oil Field Supply Stores Everywhere

B and W SCRATCHERS AND CENTRALIZERS FOR A GOOD CEMENT JOB

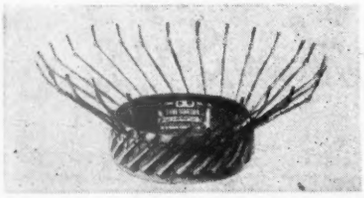
B and W LATCH-ON CENTRALIZERS

with the NEW KON-KAVE BOW

Strongest by test
Easiest to Install

and

B and W Multi-Flex Scratchers



are a GOOD Combination for a GOOD CEMENT JOB!

B and W Incorporated

• Well Completion Specialists •

WEST COAST — 3545 Cedar Avenue
Long Beach 7, California, Long Beach 4-8366
GULF COAST — P. O. Box 5266,
Houston 12, Texas, Phone: WEntworth 6603

cal solutions can be obtained for the study of reduction of tubing leak frequency with the application of corrosion inhibitors to the wells. The deviation of the last point during the corrosion inhibitor application is due to the increase of unit speed and an attempt to decrease the amount of chemical added originally to the well.

From the data obtained in the Santa Fe Springs field it can be said that the law of sucker rod breaks follows a straight line relationship with respect to time on a log-log chart, provided there is not a great variation on the considered sucker rod string as to stress, reversal frequency, partial rod string replacement, rapid change of the character of the production fluid content, or the application of artificial means to eliminate the well fluid metal corrosiveness. Mathematically this can be expressed by the following equation:

$$N = KT^n \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where N = Cumulative number of rod failures
K = Constant, whose value depends on the time the rod string has been in service without failure.
T = Cumulative time the rod has been in service, in months.
^{n} = Constant, whose value depends on the slope of the curve.

Taking the first part of the curve corresponding to Well "H" in Fig. 2, the above equation becomes

$$N = \frac{T^{4.225}}{11{,}000} \quad \ldots\ldots\ldots\ldots (2)$$

In the economic study of an oil well where it is necessary to change the sucker rod string completely due to its excessive break frequency, it is customary to assume that the new string will follow the same sucker rod performance as the old one. For the Well "H" in Fig. 2 it means that the first break will occur at the end of nine months and that the rate of breaks thereafter will correspond to the slope $n = 4.225$. The validity of this assumption is in part questionable, for there are too many factors, mentioned before, that enter into sucker rod failure. Perhaps this assumption would be more accurate if the same make of sucker rods were used to replace the old ones.

The other common economic problem of oil well sucker rod replacement is how many rods from a troublesome sucker rod string can be replaced with a future payout. At present it is very difficult to express this amount in numbers, as the slope of the remainder of the string will not be the same. This can be illustrated by the curve in Fig. 2 corresponding to Well "G" where, by changing 29 per cent of the rod string, 58 of the 64 breaks projected on the next four months were saved, which represents a good payout. By using this graphical method to record the replacement history of the sucker rods in the Santa Fe Springs field, it will be possible in the future to obtain an average slope change of the individual well in function of its percentage of sucker rod replacement. With the present average well-pulling cost and the cost of a complete sucker rod string (if available), all these well curves indicate that after 10 breaks in the rod string, the entire string can be replaced economically. This is true provided there is no reduction in pump plunger size and unit speed, that the addition of a corrosion inhibitor is not possible for the well, or that a non-destructive method of testing sucker rods is not available in the area.

In conclusion it can be said that the log-log chart for frequency of sucker rod breaks is one more tool that may be used in evaluating sucker rod performance, as well as effects on them from changes made in the oil wells. The relative position of the well curves on the chart, their slope, and their deviation from a straight line can be used to characterize the different types of operating conditions on the wells of a field. Of course, its use must be accompanied by accurate well data and the good judgment of the observer. The graphical method presented here can be used to great advantage in evaluating the effectiveness of different gadgets or corrosion inhibitors added to the wells to prevent sucker rod trouble under actual well conditions and in simplifying for the operator the determination of the possible payout on sucker rod replacements.

Acknowledgment

The writing of this paper was made possible by the assistance of personnel in the field in compiling data and by the management of the Union Oil Company of California in releasing the information for publication. ★ ★ ★

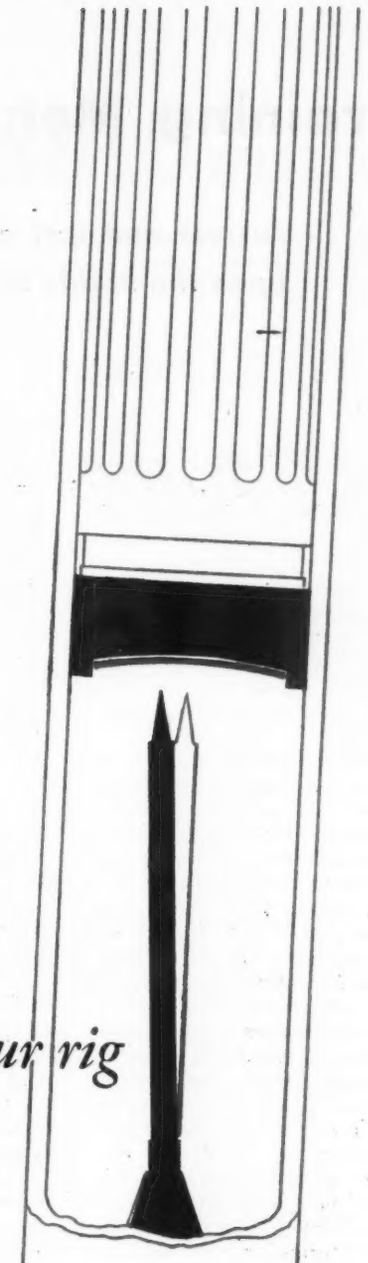
Young Speaks on Acceptance of API Standards

Standardization of oil-field drilling and production equipment, inaugurated in 1923 by the Division of Production of the American Petroleum Institute, has expanded through the years to the point where API standards are now recognized as international standards.

This was reported by Carl A. Young, of Dallas, Texas, director of the API's Division of Production, in an address before the American Standards Association. He noted that the primary factor in the international acceptance of API standards has been the "leadership demonstrated by the American oil industry in the development of drilling and production methods and in the application of these methods in foreign fields."

Young said the value of products made to API standards annually is around a half-billion dollars.

ACCURACY



—another reason for Totco on your rig

In controlled vertical drilling, your success depends on the accuracy of your drift indicator. And you can count on TOTCO —it's accurate!

Just look at TOTCO's chart head . . . you'll notice that the recess in this head is concave . . . that the accurately graduated composition chart sits firmly on this curved bottom, forming itself into a perfect arc absolutely concentric to the arc in which the angle indicator moves. This exclusive TOTCO design, small as it may seem, eliminates errors produced by a chart fixed in a flat position and insures absolutely accurate recordings.

All over the world, operators prefer TOTCO design and construction for sustained and absolute accuracy.

Be **SURE** *you know, use* **TOTCO**

TOTCO Recorder

Technical Oil Tool Corp., Ltd.
1057 N. La Brea Ave., Los Angeles 38, Calif.

Exclusive Distributors:

California—The Republic Supply Company of California
Domestic—The Continental Supply Company
Canada—Oil Well Supply Company
Export—Lucey Export Corporation, New York City

P 934.35

Training Men for Drilling Fluid Work

Success and cost of modern mud systems are dependent upon the highly specialized knowledge of mud engineers.

W. R. MAYS*

WALTER F. ROGERS in his recently published book "The Composition and Properties of Oil Well Drilling Fluids" makes several very significant statements as follows:

1. The increasing use of special mud systems requires more and more the use of trained personnel.
2. Considerable experience is necessary before a mud man becomes familiar with the different types available.
3. There is probably no portion of the cost of drilling a well that is as subject to decreased expenditures through increased education as that pertaining to drilling fluid.

These statements indicate and current magazine articles bear out the fact that the industry is aware of the need for trained men to handle the drilling fluid program. An investigation of the curricula of a few of the schools offering petroleum engineering shows that mud instruction is extremely limited. Two examples should show the general trend. One school describes a course in the catalog offered for one semester of 9 laboratory hours per week. The description shows that the course covers the chemistry of petroleum, natural gas, mud, emulsions, and porosities and permeabilities of saturated cores. Another school lists one course concerning drilling fluid. It is also a one-semester course of one lecture hour and six laboratory hours per week. This one does not include the chemistry of petroleum and natural gas but does include cement and subsurface equipment. It is obvious from these hours and the variety of material covered that the petroleum engineers are not receiving mud training. Of course, it may be that so few petroleum engineers become mud engineers that it is not advisable for them to study it in detail. Some of the mud companies take chemical engineers and train them to be mud engineers. It is doubtful, however, if a sufficient number can be so trained, especially now that the industry is drilling so many more wells and drilling them so much deeper. Who should train mud men? What type of men should be trained? What type of training course should be followed to give the necessary training?

*Instructor in Drilling Practices, Kilgore College, Kilgore, Texas.

It is not the purpose of this paper to give a complete answer to the above questions. There are a few suggestions that appear to be justified.

To begin with, it is well to review briefly the history of drilling fluid and testing procedures. It was about 1921 that the first additive was used in drilling fluid. Up until then the drilling fluid consisted of water and the formations drilled. At that time weight material was first used. It was in 1929 that bentonite was first introduced and in 1931 modern testing equipment began to be developed. Since then there has been the development of special fluids designed to overcome specific problems. These are sodium silicate, oil base, starch, lime base, and oil emulsion. We are today entering a period in which more knowledge is needed regarding the action of the mud on the formations drilled and more knowledge of the effect on the mud by the formations drilled. It is necessary then that today's mud man be thoroughly familiar with the various testing methods and in the chemistry of the several different types of muds being used.

There seem to be two alternatives for training men in schools for this work. The course can be offered as an academic course and included in the curriculum of a regular petroleum engineering or chemical engineering course, or it can be taught as a terminal vocational course. If offered as a part of an engineering course prerequisites should include general chemistry and some colloidal chemistry. Then mud can be taught as a two-semester course. If taught as a terminal vocational course the subject matter naturally falls into three sections and can be taught in three semesters of three lecture hours and six laboratory hours per week. The divisions are: (1) chemistry, (2) water clay muds, and (3) special mud systems.

It would be almost necessary for students entering such a course to have had high school chemistry and it would be better if they had had college general chemistry. The material covered in the special chemistry course would have to be governed by the student's background. The essentials of chemistry needed by a mud man would include a general knowledge of chemistry, some volumetric analysis and a lot of colloidal chemistry. It is significant that all the drilling fluids in use today are colloids and drilling fluid control might well be thought of as applied colloidal chemistry. If the student's background includes general chemistry, then the special chemistry course could go into more detail on volumetric analysis, detailed information on the common chemical reactions in mud work, and a great deal of time spent on colloidal chemistry. Some time should be spent on the chemistry of the phosphates and some organic chemistry should be included, the hydrocarbons, starches, gums, and tannins probably being the most important organic compounds. If time permits the discussion of the mud testing equipment could be included in this semester and enough tests run to familiarize the students with its use.

The second semester should be devoted entirely to water clay muds. This should begin with the basic principles of the functions and properties of a drilling fluid, a discussion of the common contaminants, a discussion of the common adverse drilling conditions. The first laboratory work could show the effect of bentonite alone and the effect of weight material alone. Then as each of the contaminants is discussed in detail along with treating methods suggested, the effect of contaminant and treating agents can be checked in the laboratory. It is good practice to try both past treatment and then pretreatment. Another suggested laboratory experiment after all four of the common contaminants have been studied is to have the students prepare a bentonite water mixture, add an unknown contaminant, test to determine the nature of the contaminant and treat the mud.

The adverse drilling conditions are not quite so adaptable to laboratory work so will have to be covered mostly in the lecture part of the course. Another subject to be covered in this part of the course is a study of the viscosity reducing agents. Here several laboratory experiments are suggested: Effect of pH, determining the effect of increasing quantities of viscosity reducing agent, comparison of the different agents, and the reversion of the phosphates. Mud calculations should also be included in this semester. Laboratory work to parallel calculations would in-

EXCLUSIVE

In cellar control gates...

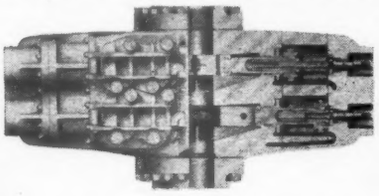
SHAFFER ALONE gives such complete selection

Bring your cellar control gate problems to Shaffer, because only Shaffer provides such a complete selection of equipment to meet varying requirements—and operator's preferences . . .

Hydraulic OPERATION

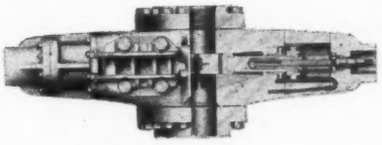
Rams are opened and closed by hydraulic fluid under pressure. Quick, convenient and readily adaptable to a wide range of control hook-ups. Shaffer Hydraulic Gates are widely used on modern drilling operations.

DOUBLE GATES



The Shaffer Hydraulic Double Cellar Control Gate provides *two* separate ram compartments—with hydraulically-operated rams—unitized into *one compact* body. Even in sizes as large as 13⅜" (12" Series 900) it requires only 30" overall height—smaller sizes even less!

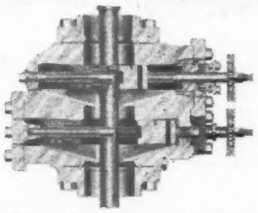
SINGLE GATES



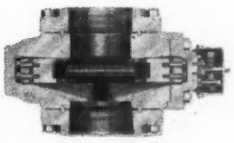
The Shaffer Hydraulic Single Cellar Control Gate can be used singly or with other Single or Double Hydraulic Gates to provide one—or multiple—ram compartments, as desired. Requires only 18½" overall height even in sizes as large as 13⅜" (12" Series 900)—smaller sizes even less!

Mechanical OPERATION

Rams are opened and closed by synchronized operating screws rotated by a compact motor drive—or rotated manually. Simple and compact, Shaffer Mechanical Gates are easy to install and give positive protection for today's drilling operations.



The Shaffer Mechanical Double Cellar Control Gate provides *two* separate ram compartments—with mechanically-operated rams—unitized into *one compact* body. Even in sizes as large as 13⅜" (12" Series 900) it requires only 28½" overall height—smaller sizes even less!



The Shaffer Mechanical Single Cellar Control Gate can be used singly or with other Single or Double Mechanical Gates to provide one—or multiple—ram compartments, as desired. Requires only 17⅜" overall height even in sizes as large as 13⅜" (12" Series 900)—smaller sizes even less!

AN ADDED ADVANTAGE—Ram Blocks and Ram Rubbers for Shaffer *Hydraulic* and *Mechanical* Gates are interchangeable, size for size. Saves on inventories, simplifies maintenance wherever both types of Gates are used!

See your nearest Shaffer representative for full details on the many unique advantages engineered into Shaffer Cellar Control Gates—or write direct!

See pages 4525 to 4600 of your 1951 Composite Catalog. Write for your free copy of the new Shaffer Catalog.

SHAFFER

HIGH PRESSURE DRILLING AND CONTROL EQUIPMENT • FISHING TOOLS THAT EXCEL

SHAFFER TOOL WORKS, Brea, California • California Service Shops: Santa Fe Springs and Taft
HOUSTON, TEXAS, 6006 Navigation Blvd. • ODESSA, TEXAS, 1925 West Second Street
OKLAHOMA CITY, OKLAHOMA, Acme Oil Tool Company, 1001 S. E. 29th Street
CASPER, WYOMING, Shaffer Tool Works, Post Office Box 1788
EXPORT SALES OFFICE: Shaffer Tool Works, 500 Fifth Avenue, New York, N. Y., U.S.A.

28 years OF OIL TOOL LEADERSHIP

THE NIGHT BEFORE CHRISTMAS

by Jolly Saint "VIC"

'Twas the night before Christmas and right down the line
Not a drop was there leaking, even one at a time,
All sections were "locked" and "buttoned-up" tight
With Victaulic Couplings that made 'em just right.

All Elbows and Tees stayed right in their groove
For the Victaulic Method each fitting did prove.
With the world's best system for making ends meet
Each pipe and each fitting was tight in its seat.

Now all of this piping so good and so quick
Was the work of none other than jolly Saint "Vic"
So for better connections in the year '52
You'd better let "Vic" do that piping for you.

VICTAULIC COMPANY OF AMERICA
1100 Morris Avenue, Union, N. J.
Mailing Address: Box 509, Elizabeth, N. J.
Phone: Elizabeth 4-2141
Victaulic Inc., 727 W. 7th St., Los Angeles 14, Calif.
Victaulic Company of Canada, Ltd., 406 Hopewell Ave., Toronto10
For Export outside U.S. & Canada: PIPECO Couplings & Fittings,
Pipe Couplings, Inc., 30 Rockefeller Plaza, New York 20, N.Y.
27TH VICTAULIC YEAR

The easiest way to make ends meet
VICTAULIC
PIPE COUPLINGS AND FITTINGS

Copyright 1951, by Victaulic Co. of America

clude calculating the weight material needed to raise the weight of a laboratory mud, adding the weight material, and checking the calculations by weighing the mud.

Whenever possible the results should be plotted in graphic form as it aids the student to understand the results of the test. A discussion of mud costs and mud handling equipment could conclude this semester.

The third semester should be devoted entirely to special mud systems. Each mud can be discussed and then tested in the laboratory. In this part of the work the books that have been published are sometimes incomplete. The material can be supplemented by articles from the trade journals and usually by correspondence with the mud companies.

At the present time there are only two books available that could be used as a mud text. The University of Texas mud manual and W. F. Rogers, "The Composition and Properties of Oil Well Drilling Fluids." The first of these was prepared and is used for a short vocational course for evening school. It is an excellent book for that purpose but it does not give enough detail for a course as outlined above. The second is an excellent compilation of all available publications to date plus a great deal of original work on the teaching of drilling fluids. The data are already a little out of date on lime base and oil emulsion fluids but will no doubt be revised and brought up to date soon.

As stated in the beginning, the drilling fluid is probably one of the best places to save money in the drilling program. To do that we need trained men. The choices are industry training, college training, or vocational training.

* * *

Stanolind Holds Schools On Producing; Processing

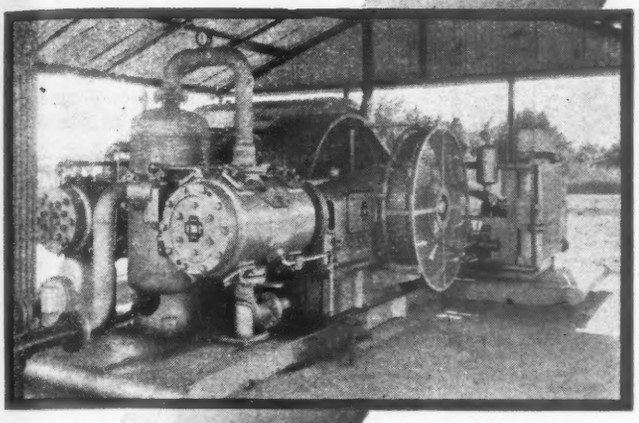
A group of 27 Stanolind Oil and Gas Company engineers went "back-to-school" recently under the company's job-training program. Recognizing the necessity of keeping its technical personnel currently abreast of new developments in the production and processing of crude oil and natural gas, Stanolind conducted two schools in Tulsa, Oklahoma, one in reservoir engineering and the other in process engineering.

During the five weeks' course, the petroleum engineers were instructed in the latest techniques for evaluating and planning oil field operations in order to obtain the maximum recovery of oil and gas. These included water flooding, gas injection, and cycling.

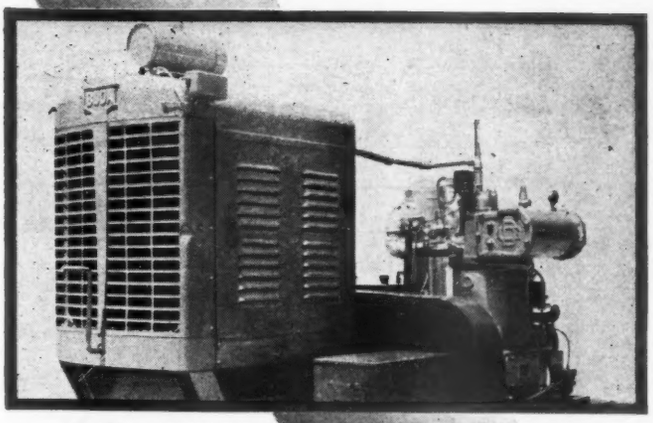
The last reservoir engineering school is the eighth held since 1948. A total of 102 Stanolind engineers, including the present class, have taken the advanced reservoir engineering course.

The reservoir engineering school was conducted by Dr. S. J. Pirson, Stanolind special research associate. James F. Pollock, senior process engineer who has been with Stanolind since 1946, was instructor of process engineering.

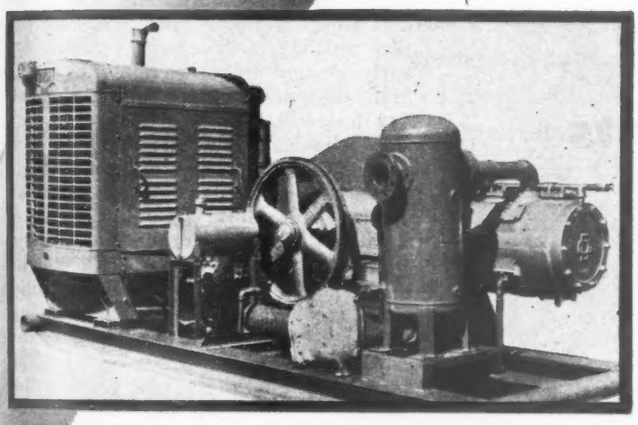
FOR EVERY PRESSURE CONDITION . . .



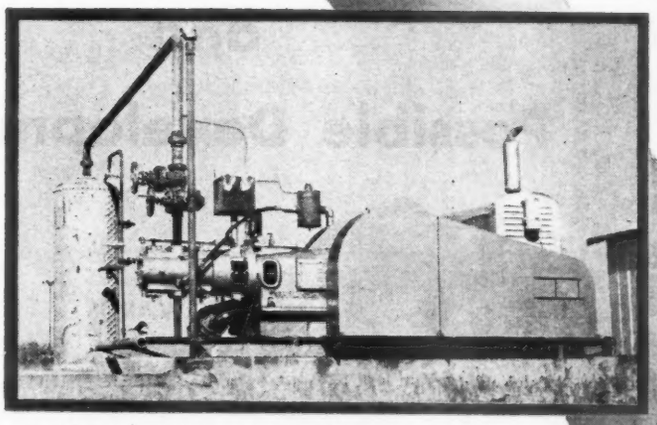
Gas engine driven 12 and 6 x 13 compressor for re-pressuring service



Engine driven model ABE for re-pressuring or booster service



Engine driven 8 x 9 booster compressor



Engine driven 5½ x 9 booster compressor

THERE'S A GARDNER-DENVER ANSWER!

Gardner-Denver packaged booster compressor units are made in a wide range of capacities and pressure ratings, from 5 to 275 horsepower.

These booster compressor units . . . featuring world-famous Gardner-Denver compressors . . . are available as portable or stationary units; with electric or gas engine drive; in single-stage or two-stage units; and with vertical or horizontal compressors.

Visit your nearest Continental store or office today . . . or write for bulletin.

PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION MEMBER

CONTINENTAL

SERVING THE OIL AND GAS INDUSTRIES

THE CONTINENTAL SUPPLY COMPANY, *General Offices:* DALLAS, TEXAS

Export Division: The Continental Supply Co., Inc., 30 Rockefeller Plaza, New York, N. Y.

The Continental Supply Company, Limited, 216 Lancaster Building, Calgary, Alberta

Representatives: ARGENTINA • BOLIVIA • BRAZIL • CHILE • COLOMBIA • ENGLAND • ECUADOR • PERU • TRINIDAD • URUGUAY • VENEZUELA

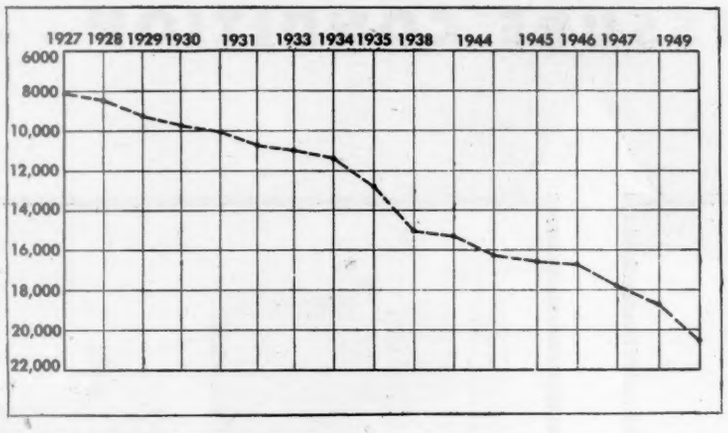


FIG. 1. Trend of drilling depth.

Slush Pump History and Possible Developments†

ROY E. EDWARDS

The purpose of this paper is to trace the role of the slush pump in the development of the oil well drilling industry and probably indicate future lines of development for this type of pump.

History

SOME form of the churn drill has been used by man since early antiquity. Even the Drake well was drilled by using this type of drill in 1859. The real importance of the drilling of this well is that an intensely active period of invention was begun at the time of the birth of the oil industry. So far as the method and equipment are concerned in the drilling of this well they are of little importance today, except historically. Since the conception of the hydraulic rotary system, as patented by Chapman in 1887, and the drilling of the first well at Spindletop in 1897, it has become the principal and major means of drilling for oil.[1]

Drilling depths have increased from 8046 ft to 20,521 ft in the past 22 years as graphically indicated in Fig. 1,[2] and today many wells are producing in the United States below 12,000 ft.

Although the cable tool rig (churn drilling method) has not become obsolete it would be hard to conceive of drilling to present day depths with such equipment, especially when high pressure gas is encountered as in South Texas, Gulf Coast, and California operations. As a point of interest, the deepest well drilled by cable tools was 10,086 ft. Surface pressures in some Gulf Coast wells range as high as 9500 psi, and in Eastern Venezuela and Trinidad approach 9000 psi. In such cases the rotary method with its slush pump and circulating system, is essential to the control of these gas pressures.

The early rotary system had no pumps. Circulation was established by pouring water into the drill stem from an elevated platform to wash the cuttings through the annulus. Later, while drilling near a windmill, someone happily thought of connecting the discharge of the windmill to the drill stem to remove the cuttings.[3]

A water well drilling contractor, B. Andrews, Sr., of New Orleans, found that a thick mud slurry would wall up the hole. This was in 1889.[3]

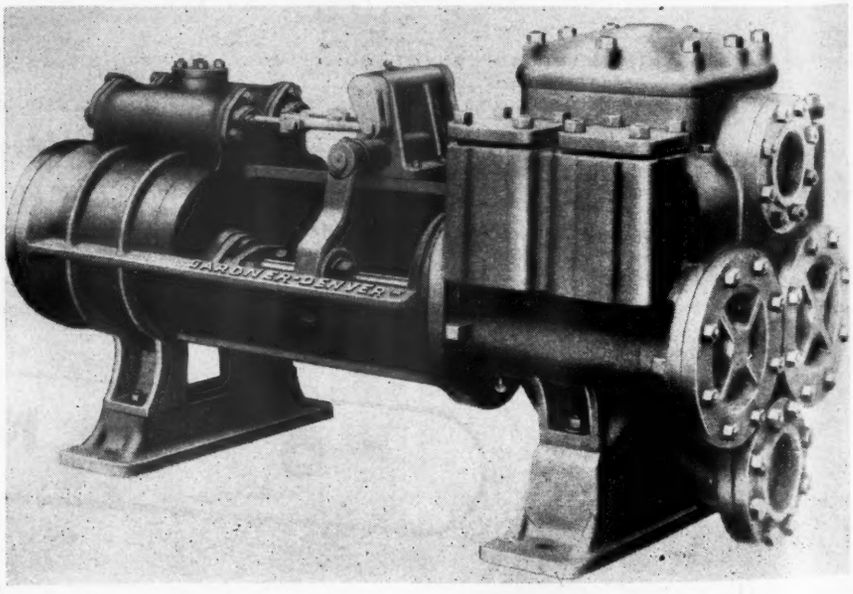
Hence the need for some type of slush pump developed.

Steam Slush Pumps

The next step was to use a boiler feed pump to circulate the cuttings from the well bore. As steam was the principal source of power at the time rotary drilling began it was only natural that the first pumps designed specifically for rotary drilling were steam pumps. An early design of rotary drilling pump that incorporated many of the present day design features is illustrated in Fig. 2. Mechanically the steam pump is a simple device of almost unlimited capacity, the only restriction for oil field use being portability. Pumps having a capacity of 900 hydraulic horsepower and weighing approximately 23,000 lb were available to the oil industry by the late thirties.[4] Today some steam pumps weigh as much as 30,000 lb, and are capable of working pressures of 4000 psi, with a stalling steam pressure of 400 psi. A volumetric capacity of 1300 gpm, with maximum pistions is available. A cross-section of a modern steam slush pump is shown in Fig. 3.

Because of its simplicity there has been little modification in the design of

FIG. 2. Early steam slush pump.

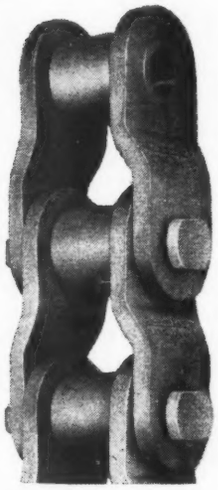


†Presented at the Petroleum Mechanical Engineering Conference, Tulsa, Oklahoma, September 24-26, 1951 of The American Society of Mechanical Engineers.

Here's chain that gets you

THERE and BACK

with high drilling speeds and heavy loads



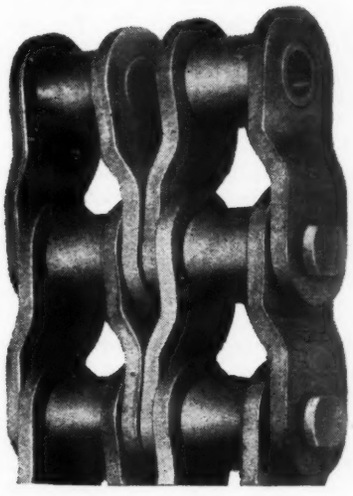
SS-3125 Hyper Single

These SS-3125 Hyper Oil Drilling Chains are engineered and accurately made to give long, trouble-free service under high speeds and heavy loads. They have great strength and durability!

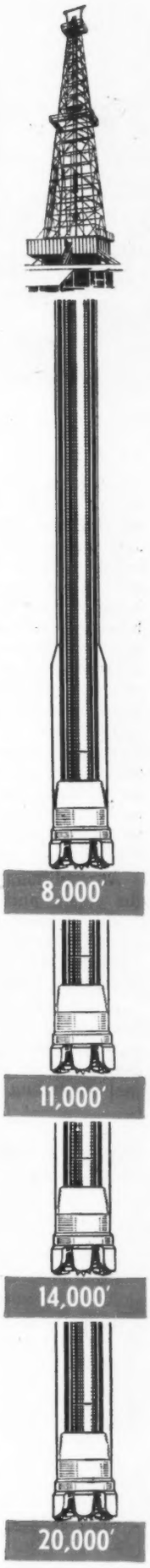
Stronger, longer sprocket teeth can be utilized. This chain can be assembled in multiple widths. Rollers of alloy steel, heat treated for maximum wear resistance; shot peened for greater fatigue life; close tolerances for smooth, easy movement.

Link-Belt Chains today represent the all-time high in chain development. L-B chain research is continuous. L-B will never stop improving chain.

SS-3125 Hyper Double



SS-3125 Hyper Triple



LINK-BELT COMPANY
Indianapolis 6, Dallas 1, Houston 1,
Los Angeles 33, New York 7.
Distributors in all fields. 12,432

LINK-BELT

CHAINS and SPROCKETS

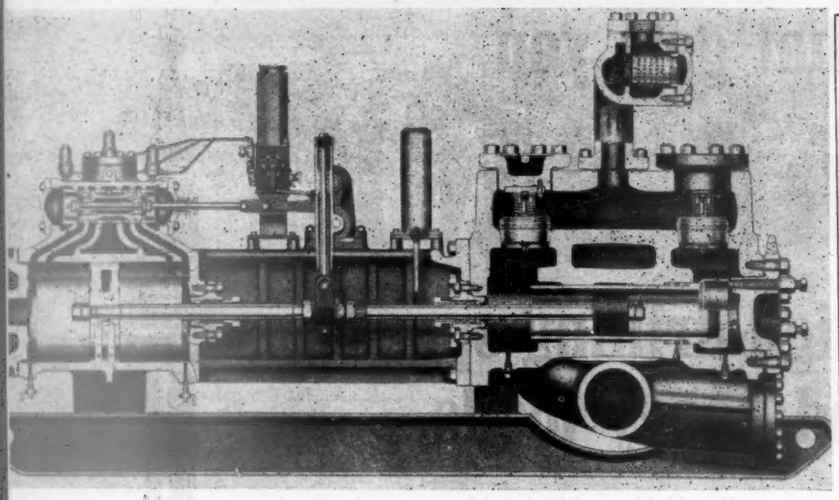


FIG. 3. Cross-section of modern steam pump.

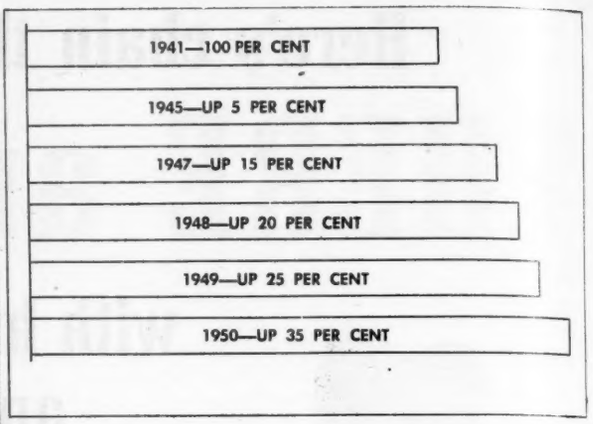


FIG. 4. Rate of increase of penetration.

steam pumps over those of earlier times, except to make them bigger and heavier to withstand the higher loads imposed, and the use of the piston type steam valve instead of the "D" slide valve. The use of the piston valve was probably brought about by valve lubrication problems caused by the use of high pressures and superheated steam in an effort to obtain more work from a given size of steam generating unit. At least two manufacturers have departed from the conventional or basic design, however. One, manufactures a double acting triplex steam pump; the other places the rocker stand and piston valve on the underneath side of the pump. The first is to achieve more capacity; the latter to achieve improved mechanical operation.

An additional factor in the favor of the steam pump was the fact that it could be used in multiples (series or parallel operation.) Hence the limiting condition was the capacity of the steam generating plant.

Unlimited mechanical capacity was offset by the economic limitations such as, the high cost of the steam generating plant, and the availability of water and fuel depending on local conditions.

Power Pumps

As the steam plant reached its economic limit, developments in the field of internal combustion engines had made available a source of cheap power. This brought about the application of the power pump to oil well drilling. The capacity of this type of pump has been steadily increased as drilling depths demanded. Possibly some of this increased capacity was the result of better understanding of the hydraulics of the circulating system and to compensate for losses imposed by the necessary restrictions in the drill stem. Before complete knowledge of the hydraulics of the circulating system was attained rigs were frequently equipped with pumps of insufficient capacity.[5]

The rate of penetration by the drilling bit has steadily increased as indicated by Fig. 4.[6] Possibly a large part of this increase is because of developments in jet drilling within the last few years. Pump output must be sufficient to maintain the required velocity to remove the cuttings from the annulus of the well bore and supply the power to overcome losses in the jet.

To obtain some idea as to the trend of slush pumps these curves were plotted from current catalog data:

Fig. 5 Horsepower vs Stroke
Fig. 6 Pressure vs Stroke, Based on Master Bore
Fig. 7 Pressure vs Stroke, Based on Smallest Rated Bore
Fig. 8 Capacity vs Stroke, Based on Master Bore

From these curves it can be seen that the drilling contractor has a relatively wide range from which to choose a slush pump.

Experiments have been conducted to determine the feasibility of supercharging or pressure flooding the suction of a power pump, increasing the speed and thus obtaining greater volumetric capacity. Although the additional displacement was obtained and valve life was increased, it was gained at the expense of the gears and bearings.

Rated speeds versus stroke for various pumps available to the industry are plotted in Fig. 9. It is wise to stay within the range indicated for various strokes.

Fluid parts have improved from the beginning as the science of metallurgy advanced and better materials became available. Liners, valves and seats, piston

FIG. 5. Available power pump range (horsepower vs stroke)

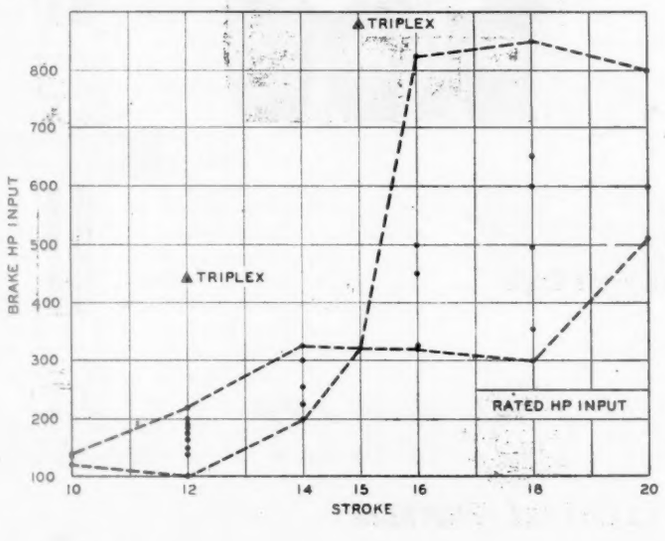
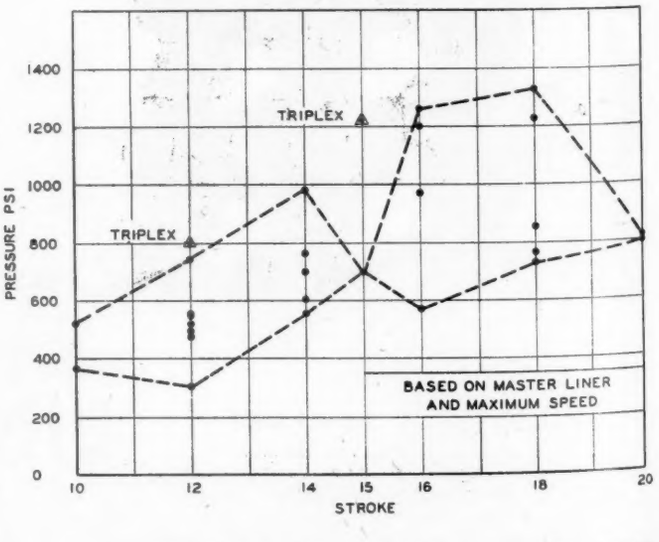


FIG. 6. Pressure vs stroke, based on master bore.



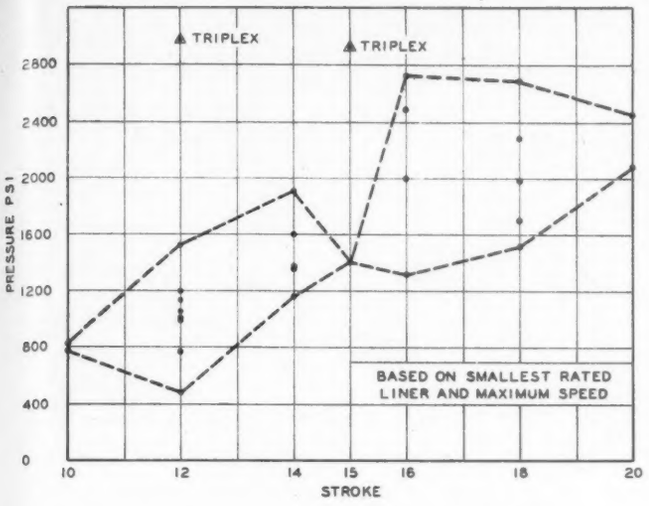


FIG. 7. Pressure vs stroke, based on smallest rate bore.

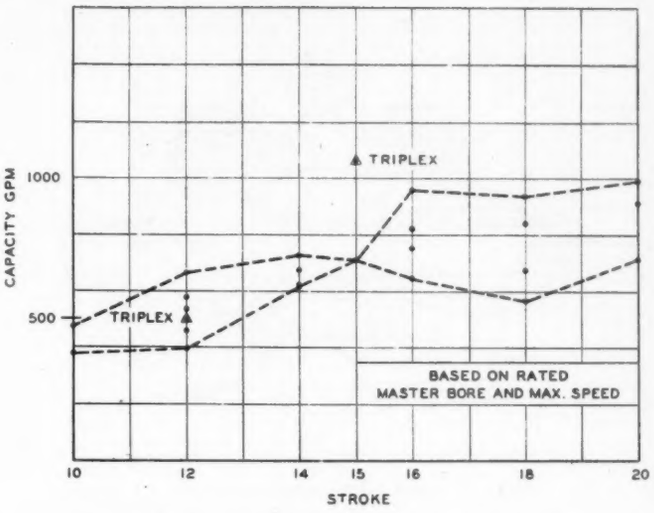


FIG. 8. Capacity vs stroke, based on master bore.

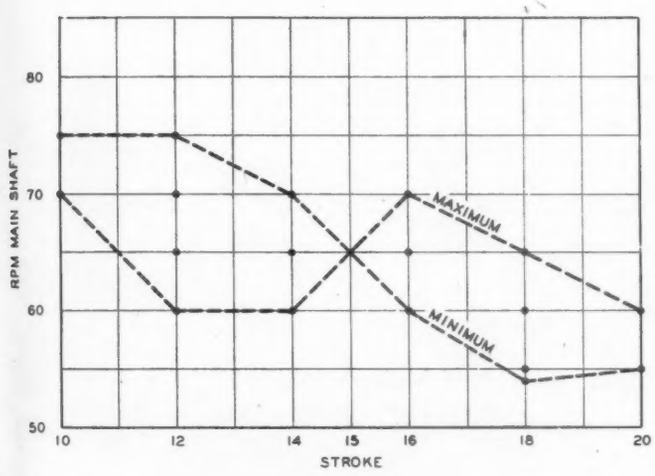


FIG. 9. Pump speed vs stroke.

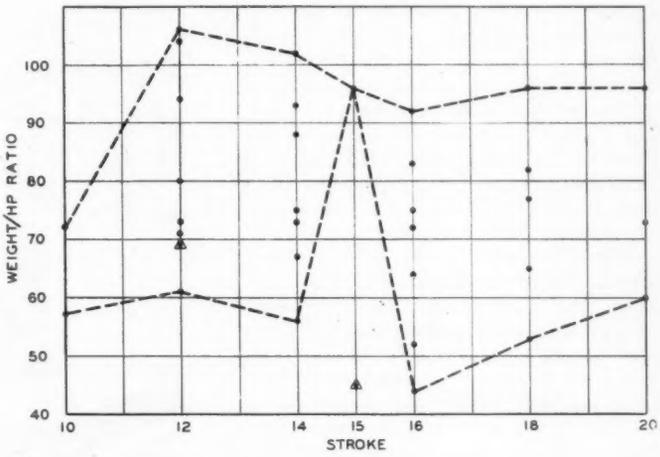


FIG. 10. Weight/hp ratio vs stroke.

rods and pistons all give reasonable life if the circulating pressures are not too high, and the sand content of the drilling mud is kept within a range of 3 to 8 per cent. From those in direct contact with the use of these parts it seems that piston wear (wear of other fluid end parts also) increases at an accelerated rate when pressures exceed 1500 psi, Piston rod wear can be reduced by continually washing the rod with a lubricant or clear water while the pump is running. If the pump is operated within rated speed valves should give reasonable life, and this life should be increased to some extent if a suction air chamber is used. There is considerable experimental work being done with ceramic plungers and liners. This seems to hold considerable promise for future development. Some users have had excellent results with a self adjusting type of packing (Vee or Chevron packing) for piston rod stuffing boxes. When using this packing special care must be taken not to tighten it too much.

An interesting attempt, not now on the market, to eliminate wear from the abrasive action of the mud on the fluid end parts is shown in Fig. 11. Careful attention would have to be paid to leakage of the fluid surrounding plunger.

The industry is ever seeking improvement in equipment and means for obtaining more work from a given piece of equipment. One manufacturer of slush pumps has produced a double acting triplex pump to reduce the effects of pump surging, and in an effort to get more work with less weight. Another concern built a six cylinder horizontally opposed plunger pump for experimental purposes. It was never commercially exploited. Recently several companies have been assisting in research in connection with a variable volume pump invented by J. E. Smith of Houston, Texas. An advantage claimed for this type of pump is that it will automatically accommodate itself to the demands of the circulating system, consistent with the power input. A 500 hp pump of this design weighs approximately 18,000 lb. Another manufacturer is experimenting with a chain drive instead of the conventional gear drive in an effort to gain a decrease in weight. In contacting various sources the one thing mentioned most, as a possible improvement in slush pumps, was "More horsepower with less weight, make them lighter but stay within economical limits." Today several manufacturers are fabricating pumps by welding the power end. Others are redesigning older models and are using alloy steel fluid ends to meet the demand. Fig. 10 shows the present trend in weight horsepower ratios plotted against stroke.

Modern mechanical improvements are, interchangeable right and left fluid cylinders, combination splash and force feed lubrication, screwed type valve covers and cylinder heads, one piece connecting rods, double baffles to keep the mud out of the power end (this is one of the main causes of power end failure), lubricated piston rod stuffing boxes, and hammer-up nuts for piston and extension rods. A cross-section of a power pump incorporating some of these features is shown in Fig. 12.

In an effort to obtain more work from power pumps they are now driven with two-speed drives, torque converters (see Fig. 13), scoop controlled hydraulic couplings, and in series and parallel operation. The two speed drive and the converter will overload a pump. This is especially true when liners are not changed as circulating pressures are increased, a practice now in frequent use when using these torque multipliers.

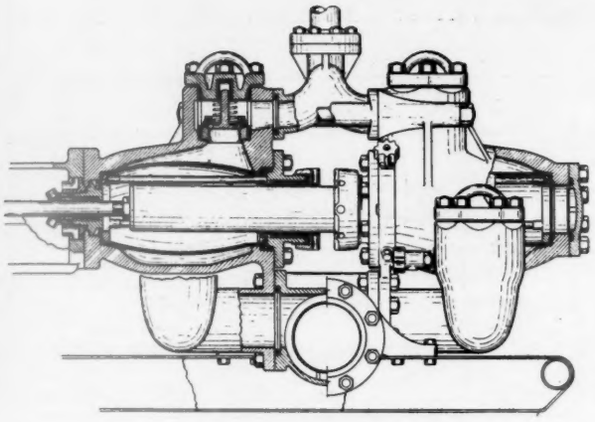


FIG. 11. Fluid piston pump cylinder.

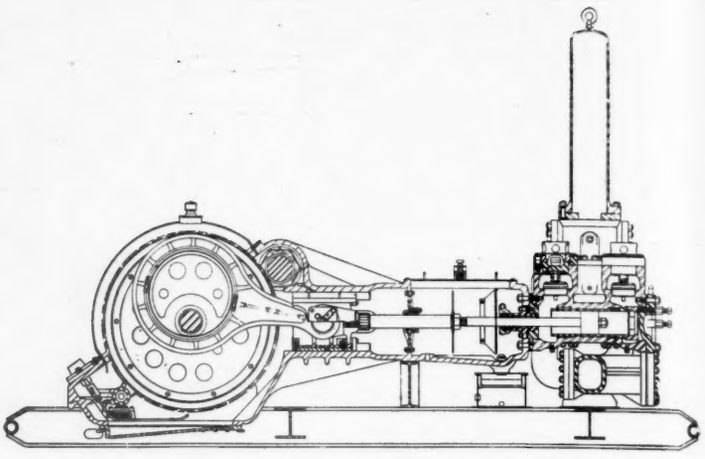


FIG. 12. Cross-section of modern power pump.

Prolonged use of this type may result in failure, depending of course on the conservativeness of the design. The reason for this is that although the frequency and effect of the dynamic loads may be decreased the "static" phase of the loading is multiplied several times. Couplings of the scoop controlled type are rather expensive for application to a pumping unit alone. If incorporated in the design of a complete rig the advantage of speed control without overloading the pump is available. Considerable flexibility can be had by using series-parallel operation without overloading the pump because the load imposed on the piston is equal to the differential load across the piston when the pumps are connected in series. This type of arrangement affords large volumes for top-hole drilling and high pressure for deep drilling. When several pumps are driven by a coupling, either scoop controlled or conventional, and have the proper type of surge chamber on the discharge they can be successfully operated in series.

The number of pumps used per rig depends on the hydraulic horsepower required and potential drilling hazards. In California one contractor uses a single torque converter driven pump down to 5000 ft and two converter driven pumps to 8000 ft. On the Gulf Coast one firm uses three steam pumps on steam rigs for deep drilling (two main pumps and one mud mixing pump), and on big power rigs they use two big power pumps. On smaller power rigs they use one main pump and a smaller one.

A multiple cylinder high speed plunger pump that offers possibilities in deep drilling as a stand-by has been on the market for some time. This pump has been popular as an oil well cementing pump, as a work over unit for oil wells and for handling mining sludge and mine dewatering. It has been used as a mud pump and several concerns are experimenting with it for this purpose. This six cylinder pump (Fig. 14), is in reality three pumps combined in one. Three plungers have a diameter of 4¾ in. and three have a diameter of 3½ in.

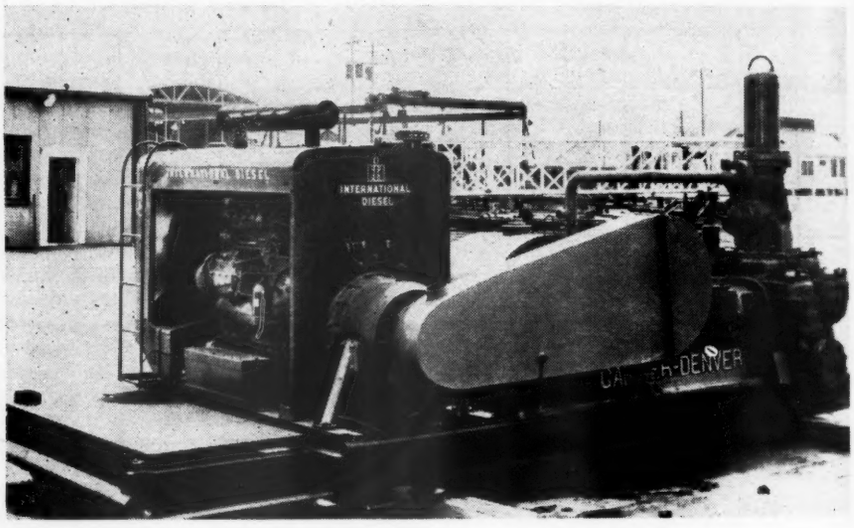
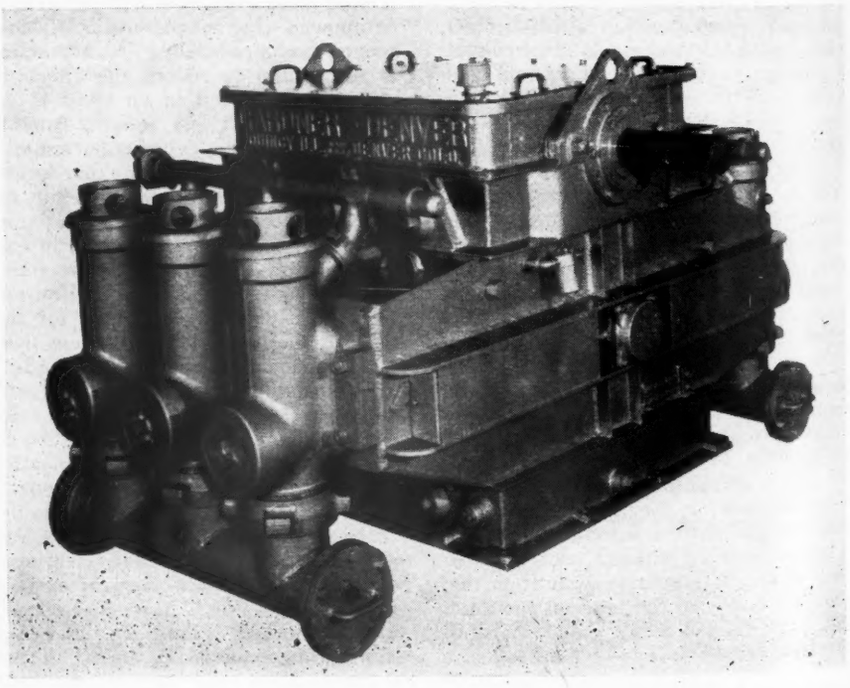


FIG. 13. Torque converter pump drive.

FIG. 14. Six cylinder plunger pump.

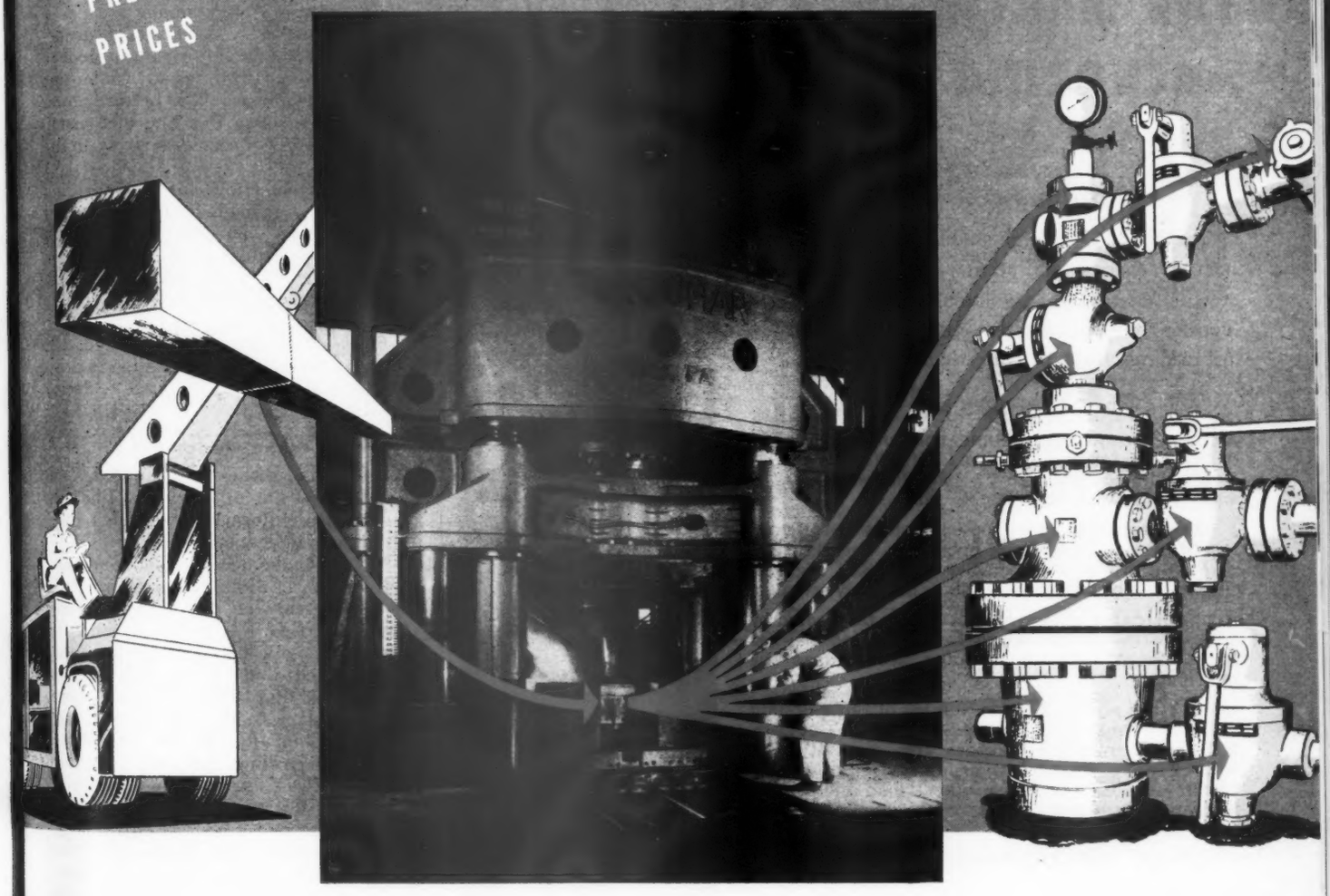


Cameron

SAFETY XMAS TREES

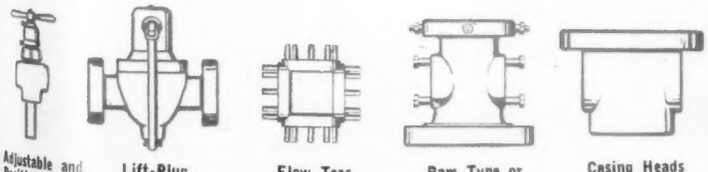
are completely forged

PREMIUM QUALITY WITHOUT PREMIUM PRICES



Forged steel is recognized as a superior material for any service — its fine grain with controlled flow patterns, its freedom from porosity and inclusions add desirable factors of safety to critical or highly stressed well head components. Here is extra quality, yet no premium price is charged for Completely Forged Cameron Xmas Trees over ordinary cast steel trees.

Cameron offers the operator the widest selection of well completion equipment, including various types of casing hangers, numerous methods of tubing suspension, both ram type and lock-screw type tubing heads, non-lubricated lift-plug valves, convertible positive-adjustable chokes, and all types of fittings.



Adjustable and Positive Chokes | Lift-Plug Valves | Flow Tees and Crosses | Ram Type or Boll-Weevil Tubing Heads | Casing Heads and Spools

Cameron IRON WORKS, INC.
P. O. BOX 1212, HOUSTON, TEXAS

Export: 74 Trinity Place, New York, N. Y. Represented in the sterling area by: British Oilfield Equipment Co., Ltd., Duke's Court, St. James's, London S.W.1, Eng.

It is possible to use either set selectively or both in combination. Table 1, gives the range of capacity. This pump is designed to take the severe overloads that can be imposed by a torque converter, and when used with one the range is extremely flexible. It could be used for mud mixing, rig wash down, to break circulation, or in any extremely high pressure operation required on a rig; also in marine and foreign operations, where rental equipment is not readily available it would have considerable advantage.

Conclusions

1. The steam slush pump is limited by the steam generating plant.

TABLE 1. Theoretical capacities and pressures for PL-7 six cylinder plunger pump.

Jack shaft RPM	Main shaft or pump RPM	Quantity and size of plungers in operation: (6) 4¾ x 7 GPM	(6) 4¾ x 7 PSI	(3) 4¾ x 7 GPM	(3) 4¾ x 7 PSI	(3) 4¾ x 7 (3) 3½ x 7 GPM	(3) 4¾ x 7 (3) 3½ x 7 PSI	(3) 3½ x 7 GPM	(3) 3½ x 7 PSI
750	125	408	945	204	1890	310	1244	109	3538
720	120	396	974	198	1948	298	1294	105	3672
660	110	356	1083	178	2166	274	1411	96	4016
600	100	321	1201	160	2410	248	1555	87	4435
540	90	288	1339	144	2678	224	1721	77.5	4976
480	80	258	1456	129	2912	199	1938	70	5508
420	70	225	1714	...	....	174	2216	61	6320
360	60	193	1998	...	....	149	2588	52.5	7344
300	50	160	2410	...	....	124	3110	41.5	9292
240	40	129	2989	...	....	...	....	35	10,000

All data based on 225 HHP or 265 maximum jackshaft brake horsepower input.

2. Lighter pumps for the same horsepower are in demand.
3. Improved mud pumps are necessary to meet the demands of deeper drilling. Since drilling rigs are predominatly powered by internal combustion engines and consequently require power pumps, it is along this line that manufacturers are continually striving to improve.
4. It appears that for deep drilling with power pumps, hydraulic drives and series-parallel operation probably will be used more extensively.
5. The use of the converter drive may require a new method of rating power pumps.
6. A plunger pump is available to the industry for possible application to drilling operations and that has extreme flexibility.

Acknowledgment

The author wishes to acknowledge the assistance of the following who liberally contributed information through personal communication:

W. S. Crake, Shell Oil Company; Bill Colvin, Drilling Editor World Oil; W. W. Flenniken, Manning Drilling Company; Geo. E. Cannon, Humble Oil and Refining Company; Joseph Zaba, Standard Oil and Gas Company; Jack Abernathy, Big Chief Drilling Company; Chas. Alcorn, Falcon Seaboard Drilling Company; H. M. Stansbury, Stansbury Drilling Company; Howard Holmes, Two States Drilling Company, and John Wilson, Wilson Manufacturing Company.

Permission to use pictures and data from the files of the following is gratefully acknowledged: Gardner-Denver Company, Quincy, Illinois, and Cameron Iron Works, Houston, Texas.

References

1. History of Drilling Technology and its Prospects Dr. J. V. Pennington, The Drilling Contractor, December 1949, pages 73 and 74.
2. Drilling Depth Records, World Oil, February 1951, page 122.
3. Rotary System of Drilling Pioneered at Spindletop, J. E. Kastrop, World Oil, January 1951, pages 283, 240, 244.
4. Mud Pump Selection, H. L. Wilke, Petroleum Mechanical Conference of ASME Paper No. 49-Pet 14, pages 1, 3 and 5.
5. Care and Maintenance of Slush Pumps, W. J. Redman, World Oil, December 1950, page 118.
6. U. S. Drilling Activity Trend, World Oil, March 1951, page 85.
7. Power Requirements for Rotary Drilling Operations, R. W. Craig, Paper No. 801-25B, American Petroleum Institute, page 3.

★ ★ ★

THE MARTIN-DECKER TYPE "D" ANCHORING WEIGHT INDICATOR

PROVIDES THE ULTIMATE

In Accurate—Sensitive—Dependable—Rugged Drilling Control and Wire Line Anchoring

The Type "D" Weight Indicator is positively unaffected by atmospheric temperature changes and accuracy is unimpaired by small amounts of air in the system, leaks or fluid volume. It shows the Weight-On-Bit by the magnified Vernier method. (Set the NET-WEIGHT-ON-BIT DIAL on zero and read.) All readings are shown directly in pounds.

The Master Drilling Control Instrument

FEATURES . . .

A CONVENTIONAL WEIGHT INDICATOR *for Total Weight of the Drill String—showing tight hole, stuck pipe, load on derrick, etc. Every weight indicator need is wrapped up in one dependable package.*

A SIMPLE RECORDER gives the engineer a permanent record of each 24 hours of operation. The Gauge is placed in front of the driller where the slightest change in hook load or bit weight is instantly revealed.

HYDRAULICALLY OPERATED—positively unaffected by atmospheric changes. Dead line whip can neither affect Weight Indicator reading nor damage the instrument.

REQUIRES NO ADJUSTMENT for Number of Lines Strung *or* Cable Diameter. No Gadgets or Shims to Get Lost. Built-in illumination provides greater safety and convenience. Furnishes precise **WEIGHT-ON-BIT DIRECTLY IN 1,000 LBS.** and also hook load and derrick load **DIRECTLY IN POUNDS.**

OTHER OUTSTANDING ADVANTAGES:

- Equally spaced gauge graduations
- No adjustments
- Safe, vapor-proof light
- Non-glare dial
- Extremely sensitive
- Sealtite construction
- Unaffected by wire line size or number of lines strung
- Adjustable sensitivity
- Saves wire line
- Simple installation

Write for Literature

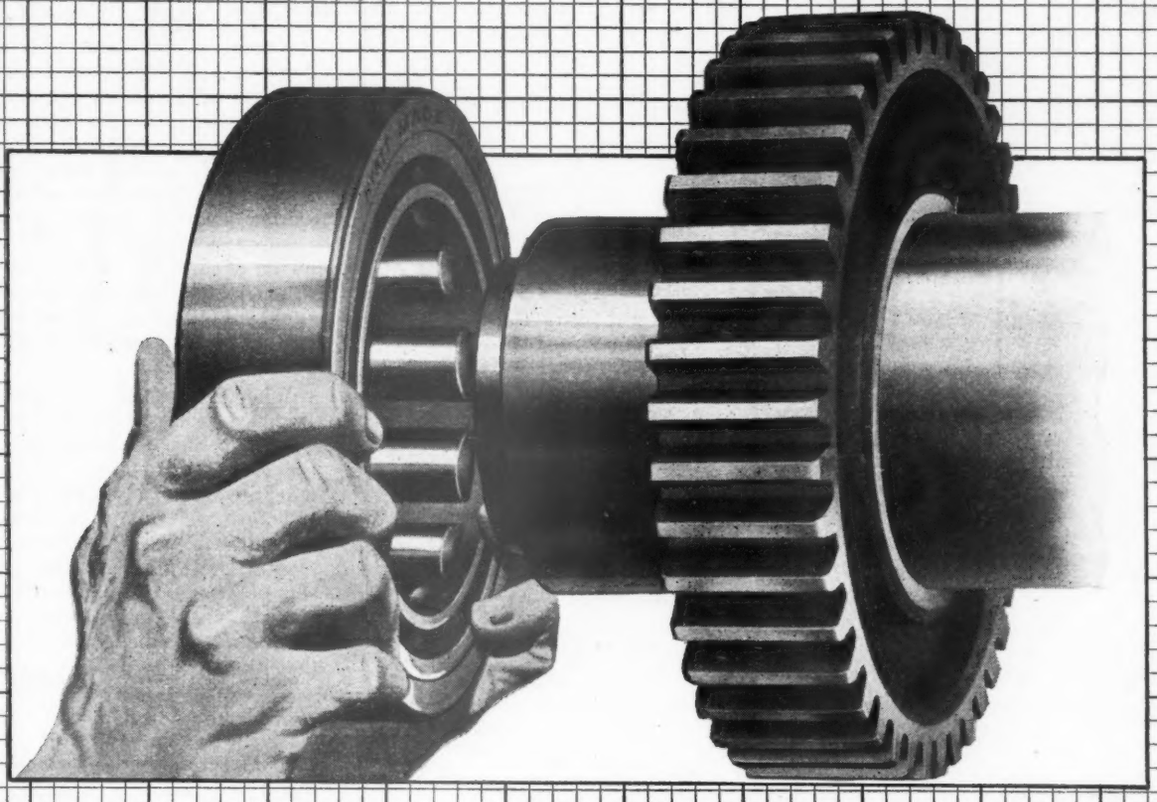
HOME OF THE WEIGHT INDICATOR

MARTIN DECKER CORP.

LONG BEACH, CALIFORNIA

SAN JOAQUIN VALLEY: T. J. CULLEN, BAKERSFIELD CALIFORNIA
MID-CONTINENT DISTRIBUTOR: REED ROLLER BIT COMPANY, HOUSTON, TEXAS
CANADIAN DISTRIBUTOR: REED ROLLER BIT COMPANY OF CANADA, LTD., CALGARY & EDMONTON, ALBERTA

MARTIN-DECKER WEIGHT INDICATORS AND IDEAL WIRE LINE ANCHORS ARE ALSO SOLD THROUGH THE NATIONAL SUPPLY EXPORT CORP., THE NATIONAL SUPPLY CO. AND OTHER RECOGNIZED SUPPLY HOUSES.



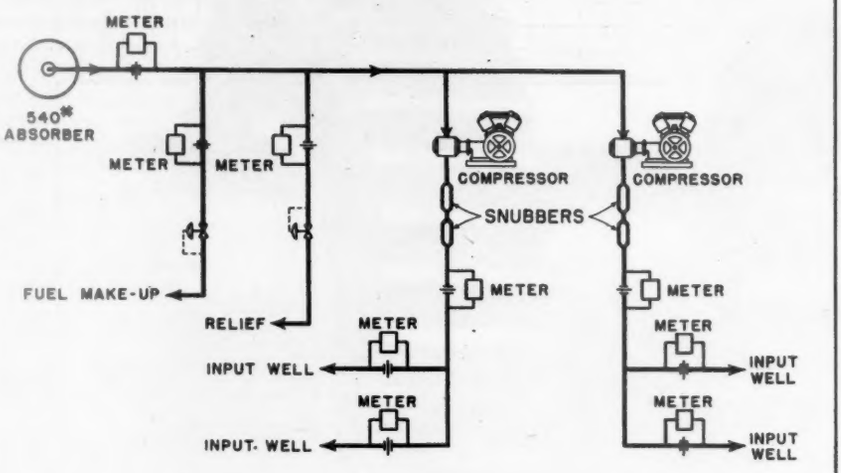
When Hyatts Go In —Bearing Wear and Care Go Out

Providing maximum load-carrying capacity in a given space, unusual ability to withstand sudden shocks or abnormal temperatures, and permitting axial shaft expansion without binding . . . no wonder bearing wear and care go out when Hyatts go in.

Aware of this, leading builders of pumping units, drawworks, rotaries, blocks, pumps, engines, and other oil-field equipment design their machines with Hyatt Roller Bearings at vital operating points—thus assuring the ultimate user of longer equipment life, smoother operation, and less maintenance.

If there is any bearing application data you may desire, write Hyatt Bearings Division, General Motors Corporation, Harrison, N. J., Pittsburgh, Chicago, or Oakland, Calif.

HYATT ROLLER BEARINGS



Installation of pulsation snubbers.

PULSATION SNUBBERS

Installation solves metering problem in gas lines to input wells used for pressure maintenance.

J. R. BAILEY*

THE purpose of this article is to show one of the values of pulsation snubbers in metering gas near compressor stations in gas injection programs.

The accompanying sketch shows a present piping, compressor, and meter system in which snubbers are installed on the discharge sides of two sets of compressors wherein gas flows from a 540-psi absorber through compressors and to input wells for pressure maintenance purposes. Prior to installing the snubbers, the system was the same as shown at present except for the absence of the snubbers and the first meter after the snubbers.

Before the snubbers were installed, the volume of gas considered to be available for injection. at the compressor suction, was determined by deducting metered volumes of fuel make-up and relief from the total volume of gas passing the first meter after the absorber. The sum of the input meter volumes on the discharge of both sets of compressors was then compared to the volume of gas passing to the compressors and was found to vary as much as 35 per cent. The volume shown by the input meters was nearly always low.

Due to lack of knowledge of what was actually occurring, the volume of gas shown to each input well was adjusted by a factor to make the total input gas equal the total gas to the compressors. Later events have proved this to have been incorrect procedure.

The erratic difference between the total of the input meters and the volume of gas to the compressors caused continual question of the procedure, and it was finally decided to install so-called master meters on the discharge of both sets of compressors in an effort to determine how the master meter volume of each discharge line would compare with the total of the input well meters on each line. It was recognized, however, that the proposed master meters could not be relied upon to register an accurate volume due to pulsation from the compressors situated some 200 ft away, and it was deemed desirable to install snubbers ahead of the master meters.

Discussion of the problem with engineers of a snubber manufacturer resulted in the decision to install tandem snubbers in each input line between the compressors and master meter as shown on the sketch.

When this installation was made, the snubbers and master meter were installed in one discharge line and only the master meter was installed in the other discharge line. This was done in order to determine any visual effect that the snubbers made upon the chart record. During a few days' operation it was determined that the snubbers prevented considerable pulsation on the chart and the other set of snubbers was then installed.

Immediately upon completion of the final installation, it was noticed that the master meter on one set of compressors checked very closely with the sum of the input well meters on that same system whereas there was considerable difference on the other system. This established by reasonable logic that there was a leak in the latter system somewhere between the master meter and the input wells, and after considerable effort, several small leaks were found. After repair of these leaks, the master meter on this system closely checked with the sum of the input well meters.

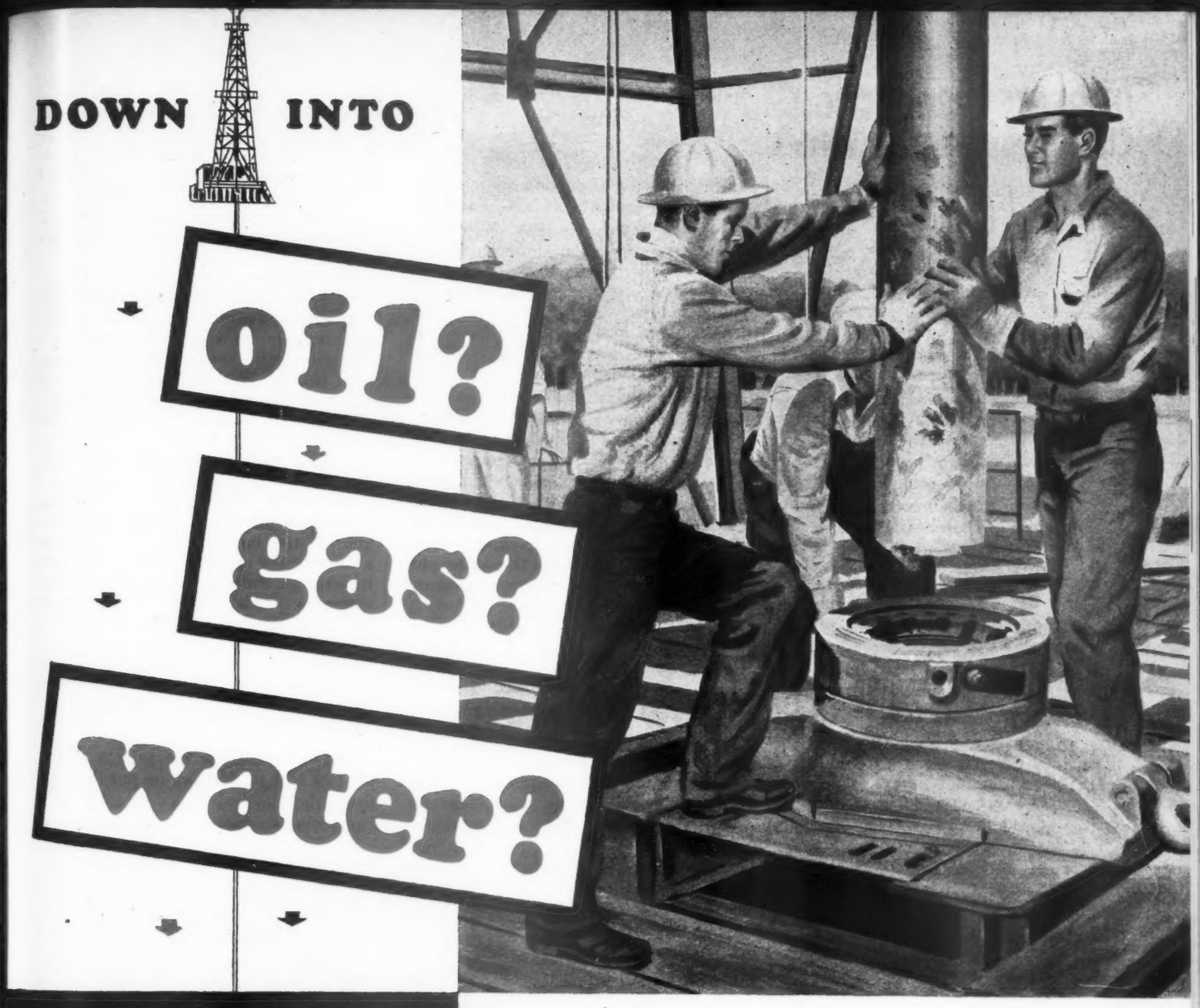
One of the main results from installation of these two master meters and the snubbers is establishing beyond reasonable doubt that the input well meters are registering, and probably always have registered, the correct volume of gas that actually passes through them.

Another result is that daily checks of either master meter with the sum of the respective input well meters gives an immediate indication of any leakage developing in the system. Early location of these leaks and their proper repair is no doubt saving a quite large volume of gas each year.

Another result has been that it is now reasonable to assume that pulsation on the suction side of the compressors is also affecting measurement on the relief, fuel make-up, and master meter on the 500-psi absorber. As these meters are not of utmost importance in accounting for the final distribution of all gas brought into the plant, the operating company has not so far seen fit to go to the expense of installing additional snubbers on the suction side of the compressors, but we are of the definite opinion that installation of such snubbers would reduce what is now an apparent large loss within the compressor station itself. The system on the suction side of the compressors is compact and tight, and the expense for additional

*Director, Natural Gasoline and Gas Operations, Continental Oil Company.

EXCLUSIVE



To know for sure call JOHNSTON

The Johnston Open Hole Tester has again taken a more important place in forming decisions as to whether or not to set casing.

With the cost of casing high and hard to get you can't afford to set casing before you know for sure whether you have oil, gas or water. The unfailing dependability of the Johnston Open Hole Tester will give you that information.

Experienced Johnston service men are available in all active areas ready to serve you twenty-four hours a day.

JOHNSTON OIL FIELD SERVICE CORP.

5702 NAVIGATION BOULEVARD — HOUSTON, TEXAS

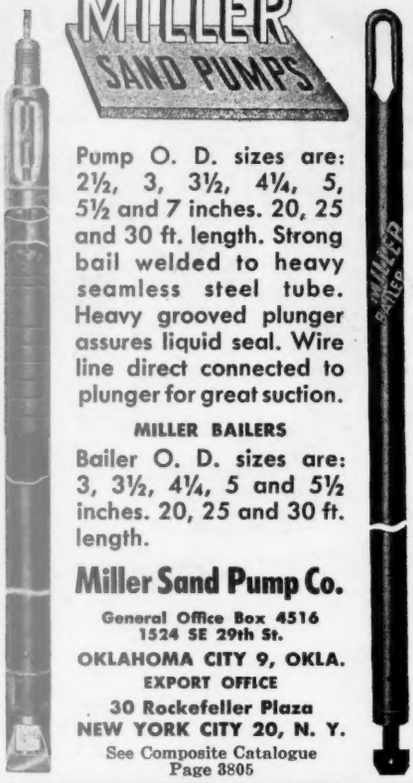
TEXAS—Houston, Beaumont, Alice, McAllen, Abilene, Cisco, Winters, Bowie, Gainesville, Graham, Jacksboro, Knox City, Throckmorton, Wichita Falls, Tyler, Victoria, Brownfield, Kermit, Midland, Odessa, San Angelo, Big Lake, Hebbronville, Snyder. ARKANSAS—Magnolia. ILLINOIS—Mt. Vernon. INDIANA—New Harmony. KANSAS—Great Bend, Liberal, Plainville, Pratt. KENTUCKY—Henderson. LOUSIANA—Houma, Lake Charles, Shreveport. MISSISSIPPI—Brookhaven. NEW MEXICO—Farmington, Hobbs. OKLAHOMA—Elk City, Healdton, Perry, Seminole, Pauls Valley.

M. O. JOHNSTON OIL FIELD SERVICE CORP.

Servicing California, Rocky Mountains & Canada

FORMATION AND CASING TESTING — JOHNSTON

INCREASE PRODUCTION
Clean Out Better With



Pump O. D. sizes are: 2½, 3, 3½, 4¼, 5, 5½ and 7 inches. 20, 25 and 30 ft. length. Strong bail welded to heavy seamless steel tube. Heavy grooved plunger assures liquid seal. Wire line direct connected to plunger for great suction.

MILLER BAILERS

Bailer O. D. sizes are: 3, 3½, 4¼, 5 and 5½ inches. 20, 25 and 30 ft. length.

Miller Sand Pump Co.

General Office Box 4516
1524 SE 29th St.
OKLAHOMA CITY 9, OKLA.
EXPORT OFFICE
30 Rockefeller Plaza
NEW YORK CITY 20, N. Y.
See Composite Catalogue Page 3805

SECONDARY MODERN RECOVERY

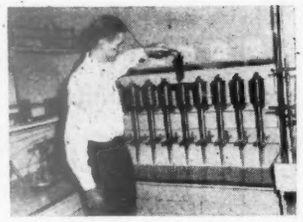
TECHNICAL CONSULTING
PRODUCTION ENGINEERING
SERVICE, INCLUDING
CORE ANALYSIS

PRESSURE MAINTENANCE WITH GAS OR WATER

REPRESSURING WITH GAS OR WATER

Retort

Inspection



Our Core Analysis
Laboratory

SURVEYS
ESTIMATES
DESIGN
INSTALLATION
SUPERVISION

PETROLEUM ENGINEERS
CABLE & STAPLES
WICHITA FALLS, TEXAS

snubbers is not considered to be justified at this time.

Supplementary Data

The following discussion of the equipment design is offered by S. G. Paddock, Burgess-Manning Company engineer:

The gas and air line snubber development evolved from investigations of means to reduce the pulsing of gas in a pipe or column open to atmosphere and driven by reciprocating or rotary machines, the pulsing or surging resulting in noise at atmosphere.

Subsequently the device was modified for application to closed systems handling compressible fluids under a wide range of pressures.

As oscillating frequencies are unpredictable, especially spurious frequencies that develop, and the determination of these frequencies requires a careful analysis of each installation, the principle of "untuned snubbing" is used to damp out pulsations.

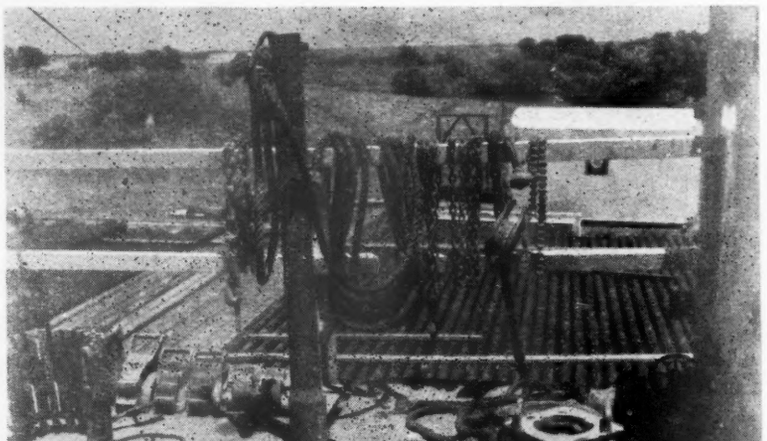
It is well recognized that vibration of gas columns constitutes something more than pressure waves of relatively small particle displacement. In severe cases this vibration constitutes an oscillating flow, back and forth at acoustic velocities and the displacement at points of maximum velocity change is relatively enormous.

The snubbers are designed in a series of stages to progressively damp out free oscillation. Fundamental frequencies are usually of greatest magnitude and being lower in frequency the acceleration is less. The peak velocity of the fundamental pulse and relative weight of gas involved, however, is great. The snubber literally "snubs" the oscillating flow down to normal velocity in one direction as required for metering.

As the snubbers are not tuned for suppression of surge at specific frequencies, and as standing pattern along pipes is not fixed, the snubbers may be situated in any convenient place ahead of the meters. * * *

How to Mount Posts On Rig Floor

To provide anchorage for a block for use in moving equipment on the rig floor, yet leave the floor clear of obstruction when additional working space is required, one contractor has the welder cut into the flanges of one of the I-beams forming the floor frame-work, and to weld into the recesses thus formed ends of tool joints so that the topmost edge of the female threads is flush with the floor.



Into these sockets thus formed short posts of drill pipe may be tonged to secure them firmly, the threaded connection of pipe into the socket being amply strong to withstand any pull that can be put on the pipe with the derrick line or that can be put through the cathead.

Special posts to fit these sockets are provided with swivels for attaching blocks. If the pull is to be in a direction not aligned with the swivel, a short length of chain can be threaded through the swivel or eye, and the snatch block suspended from this. The posts are broken out with the tongs and laid aside when the derrick floor is required to be clear. The sockets, being open at the bottom, drain clear of mud or water and do not fill with trash to impair their usefulness.—E.S.

WORKOVERS IN WEST TEXAS†

Because of the tremendous cost of wildcatting, it is important to use every means to exploit efficiently those wells already established

T. W. KIDD*

IT HAS been aptly stated that workovers, generally, are characterized by rapid expenditures, uncertain results, and slow returns. Although there can be cited individual examples in almost any field that would tend to disprove this statement, there is always a strong element of risk involved in the expenditure of funds on an oil well in an attempt to increase the production and revenue furnished by that well. In spite of the continuing advances being made in the science of petroleum prospecting, the outlay of tremendous quantities of cash is still required in wildcat drilling to establish definitely the presence or absence of oil in commercial quantities in unproved areas. This fact alone serves to emphasize the importance of efficiently exploiting the wells in those fields resulting from successful wildcats. An efficient exploitation program is the careful utilization of knowledge and experience available in order to obtain the greatest economical recovery of oil. Any improvement in a well's function as an outlet for oil from a reservoir that can be accomplished profitably, therefore, is fundamental to the exploitation program.

Workover of an oil well may be construed to include many types of work, from the cleaning of scale from the tubing to the drilling of the hole to a deeper reservoir and re-completing. For purposes of this discussion, however, let us think of "workover" as remedial work done on a producing well to increase or maintain revenue to be derived from it in producing oil from the reservoir in which it is currently completed. This may be done either by increasing production or decreasing producing expense, or both. More specifically, this includes oil production increase, gas-oil ratio reduction, and water shut-off. Any well servicing to repair, clean, or replace the flow string or lifting equipment is excluded. The examples that will be described later will reflect this definition.

Perhaps it will be of interest to review briefly the factors influencing decisions to work over wells. The procedure employed in our organization in West Texas to effect the plans for the workover of wells will be described. Finally, a few examples of workovers that have occurred in West Texas during the last two years will be discussed.

The basis for all well remedial work is the production history of the individual well. Records of individual well fluid production—oil, water, and gas—must be continually maintained and improved. Only by closely following this information can the need for special consideration of a well become apparent. All available information on the well's history from completion to date is utilized in the analysis of well troubles. Date and method of completion, initial production, gas-oil ratio trend, bottom hole pressure history, producing methods employed, present condition of the well, and past workovers on the well, are all reviewed. Core analysis data and geological data must be considered. Proration formula for the field in which the well is situated then rates attention, as any actual production increase, and the payout, will be governed thereby. History of past workovers of wells in the same or a similar field often plays a very important part in deciding what should be done to the well, as this serves as a guide to the degree of success to be expected, both mechanically and economically. Knowledge of reservoir characteristics is very helpful. It may offer a clue as to what type work might be particularly applicable, and whether calculated reserves warrant anticipating future recoveries sufficient to economically justify estimated workover costs.

Production records on individual wells are closely followed in the area and field offices. Each of the area and field offices of West Texas has in its charge a number of producing wells, ranging from about 200 at Sand Hills to nearly 800 at Goldsmith. Production foremen and engineers in each office keep up with production from day to day. Production as compared to allowable offers a convenient means of checking "shortages" of the individual wells. Most wells on the daily "trouble report", compiled from pumpers' daily production reports, present routine problems incident to production maintenance, such as scratching and swabbing, pump or flow valve servicing, or flow line repairs. When a well is shown to be still deficient in production after elimination of mechanical troubles, however, an immediate study is commenced by an engineer in the local office to explore the feasibility of a workover.

Wells with excessive gas-oil ratios are often detrimental to the reservoir, and their allowables are usually penalized. Therefore, emphasis is also placed on regaining production lost from this cause. Individual well test records are closely watched by an engineer to discover at the earliest time possible that a well's gas-oil ratio has become excessive to such an extent as to impose a penalty on its allowable.

Excessive water production from a well may bring a workover investigation, either because of deficient oil production or because of excessive expense necessary to produce and dispose of the water. Here again, the pumper, the production foreman, and the engineer work together to "keep tab" on production trends and operating costs of the individual well.

If recent tests on the well being investigated are insufficient, more data are obtained on its present capacity, gas-oil ratio, and water production immediately. Meanwhile, the past history of the well is reviewed thoroughly by the engineer assigned to the well.

Except for a few wells in old fields approaching depletion, the maximum increase in daily oil production is governed by the maximum allowable permitted under the proration formula for the field in which the particular well is located. An immediate estimate of possible increase in revenue to offset workover cost is therefore available.

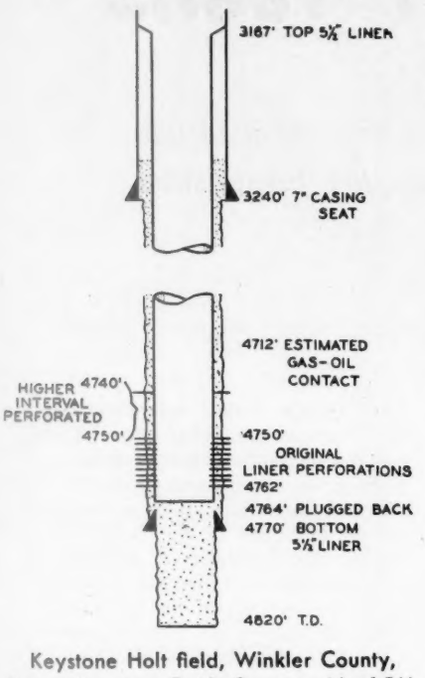
Previous workovers in the vicinity, by Gulf or by other operators, are studied, and technique of performing those past jobs, cost, mechanical difficulties encountered, payout, and permanent effectiveness of the work are all carefully considered.

The field geologist is consulted; he can give such information as location of the well on the structure, penetration, and location of oil-water and gas-oil contacts from his interpretation of data available to him. The advice of the drilling foreman is then obtained. He can give an estimate of costs, together with

---

†This paper is from the technical program of the Sixth Production Engineering Conference of the Gulf Oil Corporation held in Pittsburgh, June 18-22, 1951.

*Gulf Oil Corporation, Fort Worth production division. At present in U. S. Marines.



Keystone Holt field, Winkler County, Texas. Keystone Cattle Company No. 15 H.

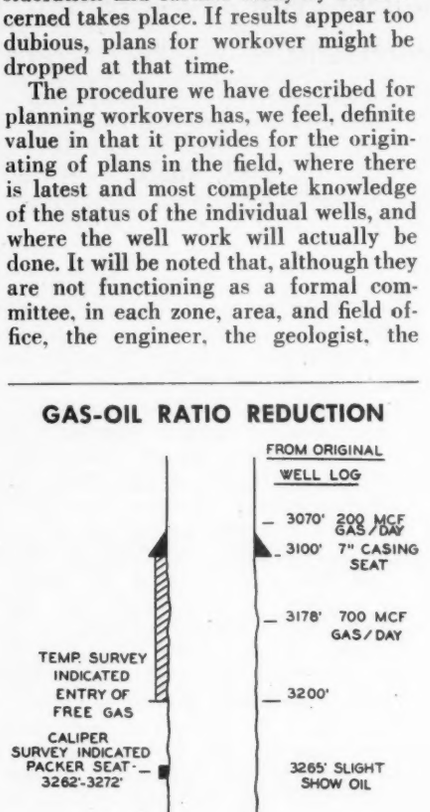
capabilities and limitations of drilling equipment and techniques. The opinion of the production superintendent or field foreman is likewise secured; he considers the risks, estimated necessary expenditures, and the calculated returns in making his decision.

A recommendation is then formulated after consultation between the engineer and the geologist, the drilling foreman, and the area superintendent or the field foreman. This recommendation is written up in a concise report, giving all pertinent data on the well's history, its current trouble, proposed procedure for working the well over, cost, and estimated payout. Often this recommendation is included as a part of the weekly engineering letter; it may constitute a separate letter of recommendation. In either case, it is submitted to the zone office, where the proposal is studied and where amendments or supplemental recommendations, if any, are added before being forwarded to the division office in Fort Worth.

For the past year, there has been in existence a division workover committee, consisting of a production supervisor, a petroleum engineer, and two members of the geological staff. This committee meets once a week and considers each workover proposal submitted by the field and area offices. In this way, no well on which recommendations have been made escapes attention, and the combined available data in the field, area, zone, and division offices are utilized in reaching a decision. Often the recommendations from the field contain recent data about the well's characteristics not available elsewhere, and on the other hand, there may be reservoir engineering, geological, or other data available in the division office not available or apparent to the field personnel when their analysis was prepared.

If the committee agrees on the proposal, word is then passed to the field to initiate an expenditure request. If alternate plans appear desirable, reconsideration and further study by all concerned takes place. If results appear too dubious, plans for workover might be dropped at that time.

The procedure we have described for planning workovers has, we feel, definite value in that it provides for the originating of plans in the field, where there is latest and most complete knowledge of the status of the individual wells, and where the well work will actually be done. It will be noted that, although they are not functioning as a formal committee, in each zone, area, and field office, the engineer, the geologist, the drilling foreman, and production supervisor jointly discuss each well considered, just as is done in the division workover committee.



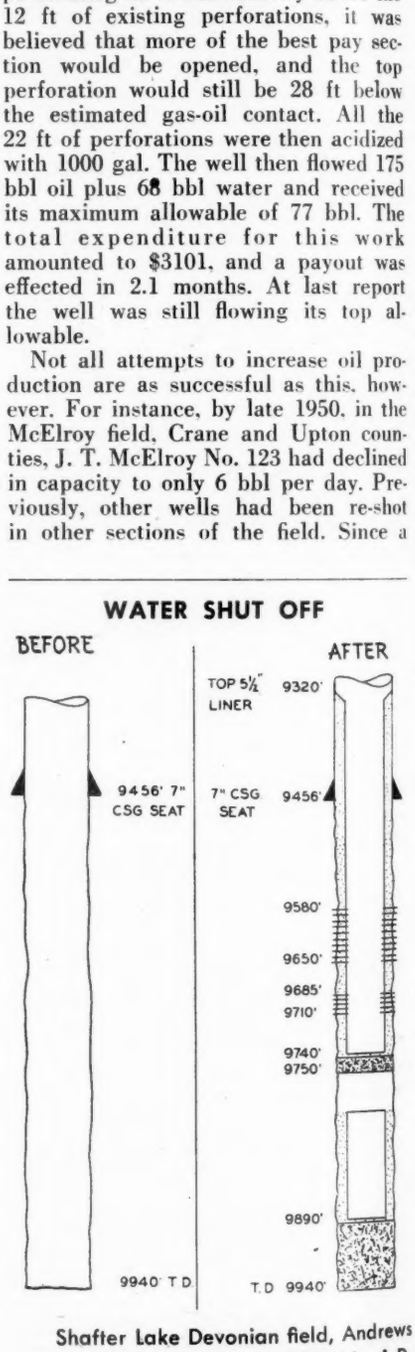
Waddell field, Crane County, Texas. W. N. Waddell No. 12.

A successful workover program requires continual analysis of individual jobs after completion. We shall see later that instantaneous production increase does not necessarily indicate the degree of success of a workover. This is one reason for our emphasis on the gathering of accurate individual well test data and utilization of this information in estimation of actual well production. Only in this way can alert follow-up analyses be made by our field engineers to determine the actual degree of success of a workover, which is measurable only in terms of the return in actual dollars to the corporation. This is vital because, as previously pointed out, analysis of results of past workovers is very influential in formulation of workover recommendations.

The following descriptions typify workovers of various types which have taken place in West Texas during the past two years.

Keystone Cattle Company No. 13-H, in the Keystone Holt field, Winkler County, was completed in the upper Holt zone. It had declined in daily capacity to 40 bbl. In November, 1950, its daily allowable and production was increased to the maximum of 77 bbl in the following manner. The well was producing, by gas lift, about 25 per cent water along with its 40 bbl of oil. It was not deemed advisable to perforate lower in the 5½ in. liner, as very likely all this would accomplish would be an increase in water production. Instead, by perforating 10 ft immediately above the 12 ft of existing perforations, it was believed that more of the best pay section would be opened, and the top perforation would still be 28 ft below the estimated gas-oil contact. All the 22 ft of perforations were then acidized with 1000 gal. The well then flowed 175 bbl oil plus 68 bbl water and received its maximum allowable of 77 bbl. The total expenditure for this work amounted to $3101, and a payout was effected in 2.1 months. At last report the well was still flowing its top allowable.

Not all attempts to increase oil production are as successful as this, however. For instance, by late 1950, in the McElroy field, Crane and Upton counties, J. T. McElroy No. 123 had declined in capacity to only 6 bbl per day. Previously, other wells had been re-shot in other sections of the field. Since a



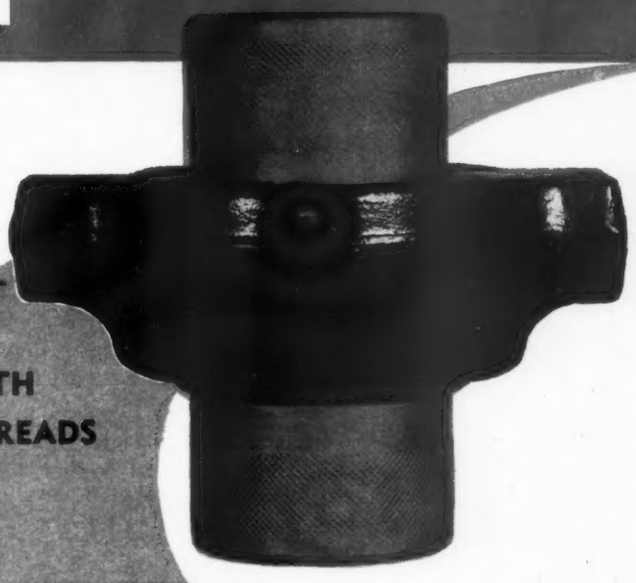
Shafter Lake Devonian field, Andrews County, Texas. Texas "PP" No. 1-D.

considerable portion of the open hole below the 7 in. casing was filled with cavings, and since the well had been shot very lightly when completed in 1935, an attempt was made to restore the well's capacity to its 24 bbl maximum allowable by re-shooting and cleaning out. Only a 3 bbl per day increase was effected by the expenditure of $3961. The future decline of the well's capacity no doubt precludes any reasonable payout of the expenditure; no further work of this nature is being done at present.

A gas-oil ratio test in March, 1950, showed that W. N. Waddell No. 12, in the Waddell field, Crane County, was producing with a gas-oil ratio of 3883 to 1, which would penalize that well's allowable from 48 bbl to 25 bbl. A study was commenced to determine what could be done to prevent loss of about half this well's allowable. The sketch shows the manner in which the well had been completed. The main oil pay appeared to be in the last few feet of the hole, while above this, there had been encountered gas zones apparently separated from the main pay by impervious strata of lime. A temperature survey confirmed the suspicion that free gas was entering the well bore between 3100 ft, the depth of the casing seat, and 3200 ft. After considering this analysis, together with the fact that satisfactory results had been obtained previously by use of a formation packer on a similar well in the Waddell field, the recommendation to set formation packer in the well was approved. A caliper survey indicated a likely packer seat at 3272 ft. Following the formation packer setting at this depth in October, 1950, the well has produced at a gas-oil ratio of about 600 to 1, and at last report the gas-oil ratio had not increased. The cost of this workover of $4627 therefore showed a payout, based on the removal of the allowable penalty which had been imposed on the well, of about 9 months. Incidentally, about $2100 more money was required on this job than the original estimate of $3400, due to the necessity of fishing out parted tubing, thus lengthening the payout period. Also, a much shorter payout time would have resulted had the anticipated 23 bbl allowable cut been used. The penalty that had actually been imposed at the time of the workover, 11 bbl, was used in calculating the 9 month payout.

In contrast to this successful gas-oil ratio reduction, in the Keystone-Holt field, Winkler County, Keystone Cattle Company No. 1-H was experiencing a continually increasing gas-oil ratio, which by September 1950, had penalized its allowable from 80 to 47 bbl per day. The well had been completed in open hole in the lower Holt pay. After running a temperature survey and a permeability survey it was determined that there was no apparent free gas zone present, and that all of the permeable section was included in the lower 23 ft of the 106 ft of open hole. It was therefore decided that an attempt to lower

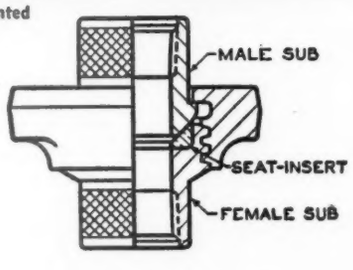
1ST. —and still the finest



6000# TEST WING NUT UNION WITH DIZZY* THREADS

WECO FIG. 600 UNION!

* Patented



The replaceable bronze seat insert in the female sub assures a surface unimpaired by rust on lines involving condensation.

With the advent of the Weco Fig. 600 Union twelve years ago operators had, for the first time, a 6000 p.s.i. test union with wing nut and the new, fast Weco "Dizzy" thread, PLUS the bonus feature of a replaceable bronze seat. The basic design of this strong, tough union has met every test of toughest oil industry service . . . withstood every challenge to its leadership in fast make-up, easy break out, strength and extra long life.

Many operators have standardized on Weco Fig. 600 because the replaceable bronze seat prolongs its use far beyond the normal service life of ordinary unions . . . because it is available in sizes 1" through 4" with all parts interchangeable . . . because it is ideal for BOILER HOOK-UPS — BLOWOUT PREVENTER LINES—MUD LINES—STAND PIPE CONNECTIONS — BOILER HEADERS—HIGH PRESSURE SEPARATOR LINES.

WECO

WELL EQUIPMENT MFG. CORP.
Subsidiary of Chiksan Company
HOUSTON 1, TEXAS
Exclusive Sales Representative Outside Mid-Continent Area
CHIKSAN COMPANY
Brea, Calif. Chicago 3, Ill. Newark 2, N. J.
Export Sales: CHIKSAN EXPORT COMPANY, Brea, Calif. Newark 2, N. J.

Manufacturers and Distributors of Oilfield, Refining, Marine and Industrial Equipment

the gas-oil ratio would not be feasible. An expense of $4240 was incurred in running the surveys, and of course there was no payout.

Water production commenced in Texas "PP" No. 1 (D), Shafter Lake Devonian field, Andrews County, in February 1949, six months after the well had been completed flowing 1413 bbl oil and no water per day. By June 1949, production was 100 per cent water and the well ceased to flow. It was closed in pending remedial action. A study of the well showed that there was a good chance of cementing a liner through the 484 ft of open hole and perforating in the upper portion to exclude water production. A bad cement job on a first liner necessitated a prolonged fishing job, consisting of cutting and fishing out all but 100 of the 538 ft of 5½-in. liner. The bottom 200 ft of the hole were finally isolated by a cement plug, and the remaining 284-ft interval between the 7 in. casing seat and top of the plug was cased off by successful cementing of a 5½-in. liner. After perforating and washing perforations with 500 gal acid, the well was returned to production. It has flowed its 137 bbl daily allowable since March 1950, with no water. Due to the costly process of fishing out the first liner in pieces, and also because of additional expense required to test an upper zone during the workover, the cost was excessive—nearly $87,000. A 14 month payout was effected, however.

A liner setting such as the one just described can be very effective in shutting off water, especially where there is a thick section to work with. Even when difficulties are not encountered, this is usually an expensive undertaking, particularly at greater depths. Consequently, it is understandable that the potential gain in oil production must be great and the chances of isolating and shutting off the water zone must be considered good before risking money for running liners in deep wells.

During the period of May to October, 1950, Gulf carried on a deepening program to increase well capacity in the McCamey field, Upton County. Eleven wells were deepened, and five of these also were treated with acid. This old field is producing from depths ranging from 1940 to 2700 ft. The reservoir is characterized as anticlinal in structure, with a solution gas and partial water drive mechanism. The pay is composed of cavernous and porous dolomite. Although we had deepened most of the wells on our G. H. Rogers et al lease in 1939, the successful deepening of McCamey wells by other operators in 1949 and early 1950 led to a detailed study of the possibility of further deepening. It was learned that there was a good chance of increasing production by deepening some of our wells that had not penetrated as deeply into the oil column as had been done nearby in some of the more productive wells of other operators. There was some evidence from individual well decline curves which indicated higher oil capacities and lower decline rates for those wells producing larger volumes of water. It was therefore postulated that

Table 1. 1950 deepening program—Gulf leases, McCamey field, Upton County, Texas

Well	Date of workover	Method of workover	Daily production: Before[1] workover Oil	Before[1] workover Water	After[2] workover Oil	After[2] workover Water	Oil increase	Cost of workover	Payout
G. H. Rogers et al									
No. 1	8-30-50	Deepen and plugback	4	3	19	34	15	$3202	4.5 months
No. 6	8-12-50	Deepen, plugback, and acidize	8	3	8	7	0	3614	
No. 8	6-30-50	Deepen	6	0	26	2	20	1594	1.5 months
No. 9	5-9-50	Deepen	7	2	26	0	19	1517	1.6 months
No. 10	9-12-50	Deepen, plugback, and acidize	13	7	25	22	12	2500[3]	4.2 months
No. 11	8-1-50	Deepen	3	3	26	11	23	1359	1.2 months
No. 12	6-15-50	Deepen	6	2	26	0	20	1295	1.3 months
No. 14	10-11-50	Deepen, plugback, and acidize	14	0	26	2	12	7400[3]	12.5 months
No. 15	7-18-50	Deepen	7	1	26	1	19	1971	2.1 months
No. 16	10-13-50	Depen and acidize	9	1	26	1	17	2378	2.8 months
					Lease totals.....		157	$26,830	3.5 months
J. H. Shirk "E"									
No. 1	10-21-50	Deepen, plugback, and acidize	4	2	26	3	11 3 (after 3 months) 1 (after 4 months)	$3498	4.8 months[4]

[1] Based on capacity tests
[2] As of 3-1-51, except for J. H. Shirk "E" No. 1. Maximum per well allowable is 26 bbl daily for the McCamey Field
[3] Estimated
[4] Would have been 4.8 months if production held up.

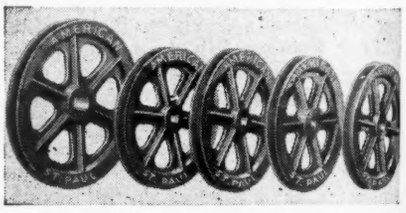
Designed to make and save money for YOU!

Design, price, installation, operation —everything about a JENSEN PUMPING UNIT is planned to make or save you money. We think it is the best way for us to make money, too!

JENSEN gives you a proven unit, tough and dependable. It starts cutting costs the day you install it, and it never quits. They have over 30 years of proven performance.

Don't be satisfied with so-called "just as good" equipment—insist on JENSENS! You'll always be glad you did. Reach for the phone and call your nearest representative, or drop us a note.

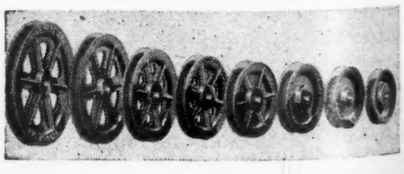
JENSEN
BROTHERS MFG. CO., Inc.
Coffeyville, Kansas, U. S. A.
Export Office: 50 CHURCH STREET
NEW YORK CITY



Everything in
SHEAVES
for wire rope

PROTECT YOUR WIRE ROPE with genuine American Hoist replacement sheaves. Same top quality used on all American Hoist cranes and other big name equipment. Complete stocks, all types and sizes. Prompt shipment from either St. Paul or So. Kearny plant.

American Hoist & Derrick Company
SAINT PAUL 1, MINNESOTA
SO. KEARNY, NEW JERSEY



Moore

Economical Operations for....

SHALLOW WELL DRILLING
DEEP WELL SERVICING

Two trucks are all you need to transport the Lee C. Moore 87′ and the 96′ Cantilever-Type Masts. All assembling is done on the ground, and in minutes the mast can be raised to drilling position. Because of the 87′ and 96′ masts' ease of transportation, speed of erection and rugged construction, you can always be sure of economical shallow well drilling or deep well servicing.

Lee C. Moore 87′ and 96′ Cantilever-Type Masts are fabricated in four welded sections, and skid base. Can be used with standard rotary table and other equipment. Has a nominal capacity of 300,000 lbs. Furnished complete with Crown block and racking platform.

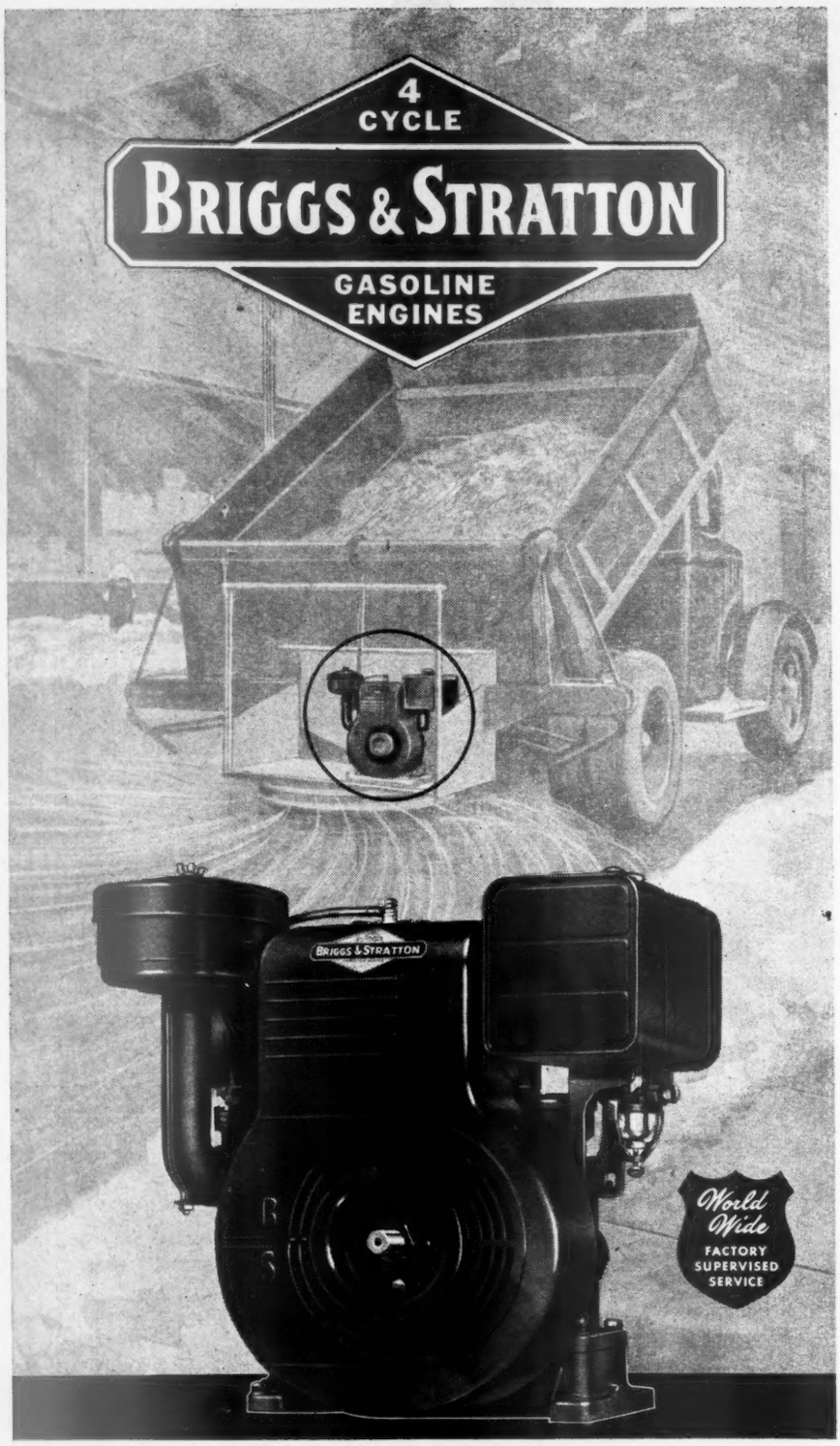
WRITE FOR BULLETIN

LEE C. Moore

LEE C. MOORE CORPORATION

TULSA • DALLAS • HOUSTON • MIDLAND • SHREVEPORT • WICHITA • CENTRALIA • PITTSBURGH

Export Office — 9 Rockefeller Plaza, New York 20, N. Y.



Preferred power for sand and material spreaders and a wide range of other equipment for road maintenance and construction — the world's most widely used single-cylinder gasoline engine on machines, tools, appliances used by industry, railroads, oil-fields, and on equipment for farm and home.

BRIGGS & STRATTON is the world's largest builder — more than 30 years of continuous production — of single-cylinder, 4-cycle, air-cooled gasoline engines. Briggs & Stratton Corporation, Milwaukee 1, Wisconsin, U.S.A.

In the automotive field Briggs & Stratton is the recognized leader and world's largest producer of locks, keys and related equipment.

if porosity and permeability were continuous near the oil-water contact, the flushing action of water produced through this transitional zone could make possible the recovery of more oil. It was this theory which had prompted the deepening by one off-set operator.

The tabulation gives some of the pertinent data on the eleven Gulf wells deepened. The remedial work on these wells consisted merely of deepening with cable tools an average of about 15 ft. In some cases, where large volumes of water were encountered, a bottom plug of hydromite and lead wool was set in order to exclude excessive water production. Also, if satisfactory oil production was not obtained after deepening, the well was acidized. Eight of the 10 deepening jobs on the G. H. Rogers et al Lease were successful, showing payouts of 4.3 months or less. One was a failure, since no oil production increase was effected, and the tenth well will pay out in 12.5 months if its production rate continues at the present level. Considering the 10 wells as a group, a daily oil increase of 157 bbl was obtained, which, incidentally, was being maintained as of March 1, 1951. Total expenditures amounting to $26,830 therefore were paid out in about 3.5 months.

The deepening, plugging back after excessive water was encountered, and acidizing the one well on the J. H. Shirk "E" Lease was unsuccessful, although the initial oil production increase indicated a payout period for the $3498 expenditure of 4.8 months. As shown on the tabulation, however, capacity of the well declined rapidly and was only one barrel per day more than its pre-deepening capacity four months following the workover.

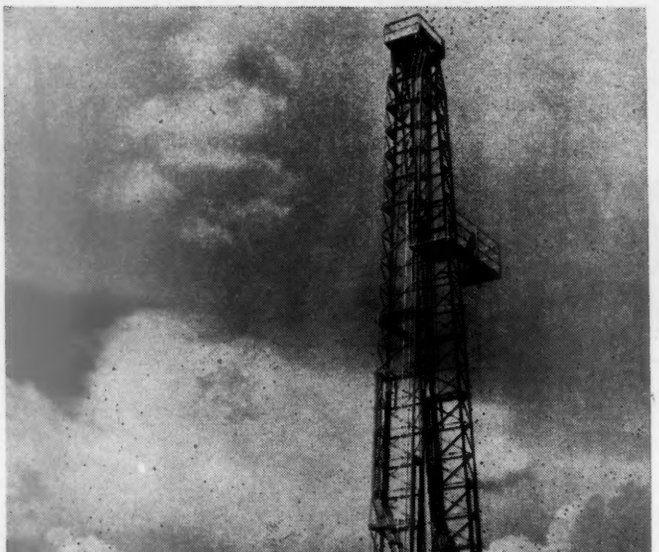
The several workovers we have briefly described are typical of the remedial work that is being carried on in West Texas. Noticeable by their absence are casing repairs, which are becoming more frequent because of corrosive fluids and because the pipe in many wells of the Permian Basin is exposed to the thick salt section prevailing in most localities there. It will also be noted that no case histories of re-completing wells in deeper reservoirs or in reservoirs previously penetrated and cased off have been given. We feel that each of these methods of increasing or maintaining oil production from a well is a very important type of workover, but chose in this discussion to emphasize only the efforts to more economically exploit those reservoirs from which our wells are now producing.

We have attempted to show that the whole workover program is dependent on the coordinated gathering and utilization of all the data possible for both the individual wells and the reservoirs by the production, engineering, and geological staffs.

Although not every job is a success, through the combined efforts of all concerned, every attempt is made to make each dollar spent for workovers a successful investment. ★ ★ ★

Merry Christmas

from Jarring Jerry and all the Johnston gang



Field view of the Ideco full view drilling mast erected and ready for work.

Side view of mast in working position to emphasize clearance for lines and traveling block.

NEW WELDED FULL VIEW MAST

A combination of welded and bolted design has advantages of the standard drilling derrick and of light portable rig

J. B. McCORMICK*

PAST experience proves that some design engineers are prone to go overboard in following a trend. The net effect of this attitude is usually to undermine the very principles they are attempting to extend. Efficient design is largely a matter of compromising techniques to obtain maximum service efficiency of the product. Any deviations from this course are liable to produce dissatisfaction.

Engineers of Ideco-Division of Dresser Equipment Company were obviously of this opinion while designing the new "Full View Mast" that is now meeting with wide acceptance in oil fields throughout the world. Although the new mast is essentially an all-welded structure, the monolithic design principle has not been carried to the point where it interferes with portability. Welding gives the structure added strength and stability, but at the same time, enough bolted and pinned breakdown joints have been provided so that the mast can be disassembled to a degree compatible with the distance it must be transported and hauling conditions enroute. For long-distance transport purposes, or for overseas shipment, the mast can be broken down into all-welded monolithic panels, sized to nest with each other and contain the various bolted bracing girts and diagonals. It is a good example of how design trends—in this case bolted structure versus all-welded structure—can be blended to produce maximum customer satisfaction.

The Ideco full view mast was designed primarily to combine the advantages found in the standard drilling derrick with the lower cost inherent of moving and rigging up a drilling mast. It is an "A" frame structure that makes full use of the advantages of compression-shear loading caused by vertical (dead

*Welding engineer and district manager for the Lincoln Electric Company at Los Angeles, California.

EXCLUSIVE

weight and working load) and horizontal (wind loads, pipe lean, etc.) components of force. The frame is held upright by a pair of auxiliary legs that serve also as a part of the raising mechanism. The unusual design of the mast provides unlimited visibility, a great area of clear working floor space, and maximum safety. Placement of the girts and diagonal braces completely within the legs of the "A" frame leaves an unobstructed channel of view between the driller, the derrick man, and the traveling block.

In the development of the prototype mast, the conventional line diagram method of stress analysis was used. Low carbon steel in angle shapes was chosen as the structural material due to both its availability and excellent weldability. All stress calculations were based on the yield point rather than the ultimate strength of this material. A substantial margin of safety (meeting all Code requirements) was included in the design. Mast strength in all sections was predicated on the highest stress load it would encounter during service, whether this load accrued from erection, working stresses, windage, or loads incident to handling and hauling.

With a view to saving time in all areas, and expediting use of the mast in isolated areas, every step necessary to its assembly and erection was engineered to require a minimum of labor and outside equipment. The mast can be moved easily and quickly by the drilling crew and does not require a rig building crew with special equipment.

The fundamental components of the mast consist of welded monolithic panels bolted together to form the leg sections. These sections, in turn, are either end-bolted or pinned together to form the full-length legs. The auxiliary raising and bracing legs and tackle equipment fold inside the lower main leg sections to provide a more compact package while moving.They are thus reeved and ready to go when the new location is reached.

The widespread legs of the mast provide ample room for drilling rigs of any size, with plenty of clear space around the catheads. Overall size of the drilling floor is 24 ft from drawworks to pipe ramp, and 27 ft 8 in. from side to side. This gives ample room for an independent rotary drive when and if it is needed.

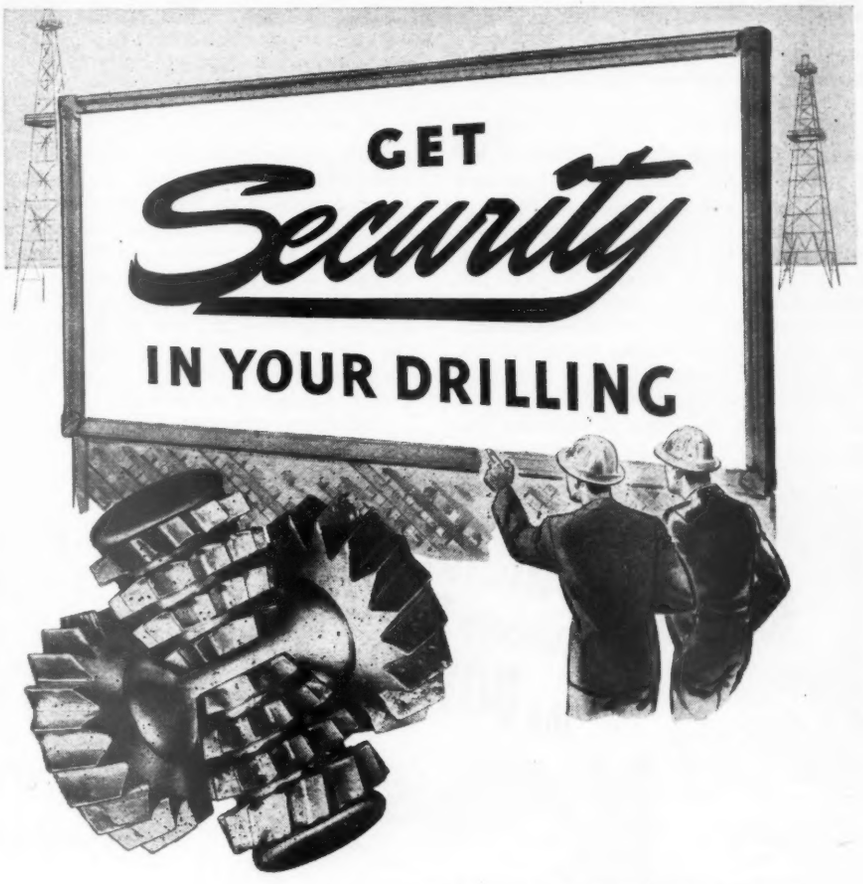
One feature of the mast is its unusual stability. This is obtained from the widespread placement of the four legs, and aided by the welded lattice-type box construction of the two main legs. The main legs have a cross sectional dimension of 3 ft 6 in. by 7 ft, and are joined at the top by the crown block and by two "X"-shape stiffener trusses. The inside latticework is omitted near the top of each main leg to provide clearance for the traveling block. The main legs taper near the bottom and culminate in an all-welded pin housing that provides pivotal mounting on the base pedestals.

Design of the substructure follows the principles used in the design of the main legs. It is composed of all-welded monolithic panels bolted together to form twin-box structures, each 7 ft 6 in. wide. These boxes are quickly assembled into a complete substructure by joining them together with sledge pin connected members. Quick float away of the mast without the necessity of jacking it up can be accomplished by removing the front connecting members. Design of the substructure provides ample room to facilitate installation of well head control equipment. The rotary beams and flood panels are removable to provide a 7 by 12 ft opening at the center of the hole for placement of the rotary table.

The rathole position is directly opposite the well so that it may be drilled by turning the table 180 deg. Since the rathole position is within the mast structure, almost full hook load pull can be exerted to break loose a stuck Kelly.

The method of raising the mast is unique. No gin poles or auxiliary rigging equipment are required. A simple lever and tackle arrangement, with power applied by the drawworks, accomplishes the job in a minimum of time.

The raising mechanism consists of the two auxiliary legs, a block-and-tackle arrangement, and a roller-and-track system. The auxiliary legs are 40 ft long, and are made up of two 12-in. channel sections welded together to form a box

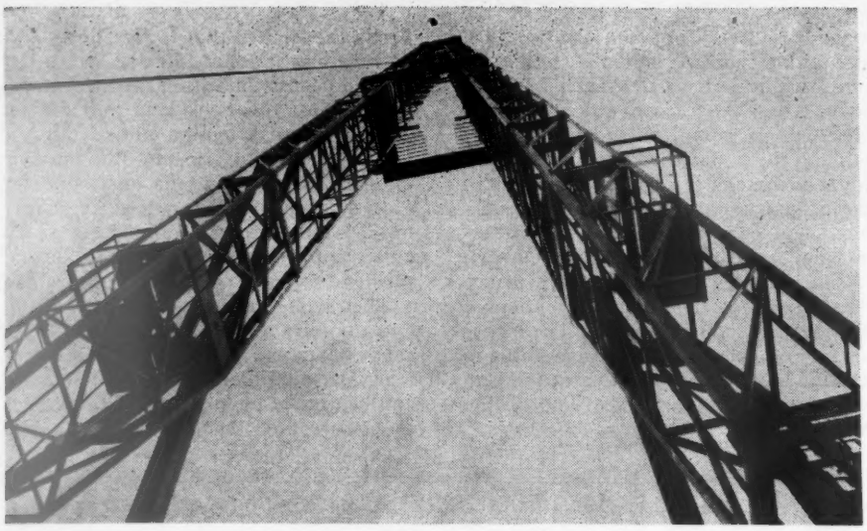


"Get Security in Drilling" is our way of saying "get security in *your* drilling" through the use of efficient, dependable equipment. For over 20 years Security Engineering has designed and manufactured subsurface drilling equipment to meet the exacting demands of the oil and gas industry. With a complete line of rock bits, reamers, hole openers, casing scrapers and reamer rock bits, backed by field-tested design and precision manufacturing, Security is meeting today the current requirements of intensified drilling activity. Inspection will show consistently high drilling performance when you use Security products. For this security in drilling, get SECURITY in your drilling.

GET Security IN DRILLING

ONE OF THE DRESSER INDUSTRIES
SECURITY ENGINEERING CO., INC.
MAIN OFFICE AND PLANT: WHITTIER, CALIFORNIA
BRANCHES IN ALL MAJOR PRODUCING AREAS
EXPORT OFFICE: CHANIN BUILDING, NEW YORK CITY

ROCK BITS • REAMERS • HOLE OPENERS • CASING SCRAPERS • SECURALOY



Looking upward from drilling table to illustrate the "full-view" principle.

section. One end of each auxiliary leg is pinned to the substructure at ground level. This pin assembly includes a self-aligning sleeve-type bearing that allows some lateral movement of the raising legs as the mast is lifted to the vertical. The opposite end of each auxiliary or raising leg is fitted with rollers that ride in welded tracks running down the inside of the mast legs.

As the traveling block moves toward the crown of the mast, it pulls on the raising lines which are reeved block-and-tackle fashion inside the bottom mast sections. This forces the rollers on the end of each auxiliary leg inward along the track welded on the inside of each main leg. The net result is to shorten one side of the triangle formed by the main leg, the auxiliary leg, and the line between their pivotal points. As this action continues, the main leg assumes an upright position.

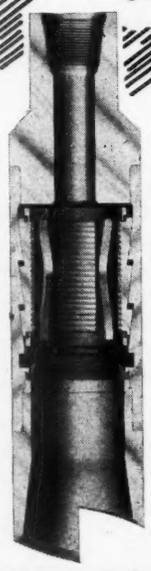
Automatic safety locks, strengthened by welded construction, consisting of spring-loaded plungers or pawls and toothed cams, are engaged by the roller shafts as the mast approaches the vertical. Additional safety is provided by manually operated locking jacks so that no movement of the raising mechanism is possible when the mast is erect.

Design of the mast prevents its going over center when erected. When the mast is in drilling position, the center of gravity is situated slightly on the pipe rack side. After the mast is erected, the raising lines can be disconnected and stowed in coils under the mast leg base pedestals. When it comes time to lower the mast, the automatic locks are released from the drilling floor by pull ropes connected to the spring-loaded pawls. The slightly off-center position of the mast will tend to start it downward without having to jack or pull it from a dead center position.

The recking platform is attached to the mast by four "U" bolts, and serves as an intermediate stiffening truss for the main legs. A heavy back strut is attached below the racking platform on the opposite side. This strut serves also as a pipe catcher. The platform may be positioned at three elevations within a 10-ft range. Drill pipe always leans in the direction of greatest mast stability, and fingers for catching the pipe are provided on either side. The welded platform railings are 6 ft high to facilitate attachment of a wind-break canvas.

The center catwalk is hinged to allow

for Rugged OUTSIDE Holds on Stubborn Fish . call for the BOWEN socket



Husky overall construction and simple operation make the Bowen Socket ideal for outside holds on the toughest fish. Yet this tool is readily released whenever required, even after hours of jarring.

Made in two types—the L & L for all general purpose work, and the Crown Type for use where only a short hold is obtainable on the fish. Double-bowl assemblies can be supplied for catching drill pipe or tool joint. Available with or without pack-off features, in all popular sizes. *Call your nearest Bowen Service Store.*

SR BOWEN CO

MAIN OFFICE AND PLANT
11004 SOUTH NORWALK BOULEVARD
SANTA FE SPRINGS, CALIFORNIA
EXPORT OFFICE
30 ROCKEFELLER PLAZA
NEW YORK CITY, NEW YORK
EXPORT REPRESENTATIVE: [illegible]

You SEE where you're going

when you use

GEOLOGRAPH

No need to step into trouble! You SEE formation changes, automatically recorded on Geolograph charts, foot by foot, as you drill! You get up-to-the-minute, accurate drilling data 24 hours a day. That's why you save when you log as you drill, with Geolograph.

GEOLOGRAPH
MECHANICAL WELL LOGGING SERVICE
P.O. Box 1291 • Oklahoma City 1, Okla.

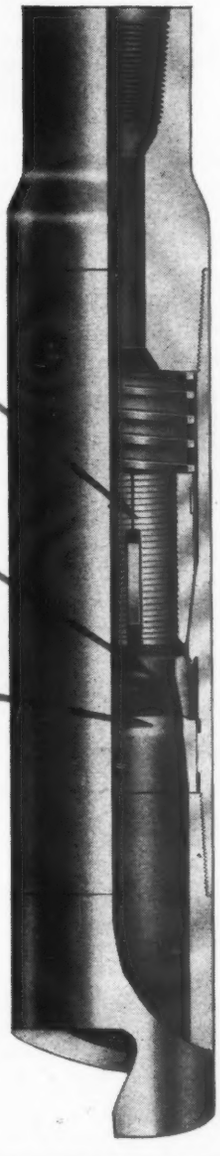
ABILENE, HOUSTON, ODESSA, LUBBOCK & WICHITA FALLS, TEXAS
BAKERSFIELD, CALIF. — SHREVEPORT & BATON ROUGE, LA.
CASPER, WYOMING — OKLAHOMA CITY, OKLA.

BAASH-ROSS TOOL CO. • OKLAHOMA CITY • NEW YORK

Baash-Ross News

OUR 32nd YEAR

Check These Advanced Features of the BAASH-ROSS "OK" Circulating and Releasing Overshot



THREE-SEGMENT UNITIZED SLIPS give a more uniform grip—both *around* the fish as well as vertically!

PACKING RUBBER seals below the slips. When you have a grip you have a *positive* pack-off!

PROTECTING GLAND can be either plain, or with milling surface for trimming burrs!

LOOK INSIDE for the answer to—

Full Uniform Grip . . . *Positive* Pack Off . . . *Simple* Release . . . *Maximum* Adaptability!

When you need quick action in recovering stuck drill pipe, tubing or casing, the Baash-Ross "OK" Circulating and Releasing Overshot provides unique advantages (as outlined below) that assure a quick, positive grip on the fish . . . full circulation through the tool, if desired . . . and equally-positive release in the event the fish cannot be loosened. Product of years of experience in fishing tool design, the "OK" may be run as a single bowl unit, or as an assembly of two or more bowls with different-sized slips to catch varying diameters—and a wide range of accessory equipment is available to meet special operating conditions.

SIMPLE, TROUBLE-FREE DESIGN

Note in the cross-section view at left the simple design and minimum number of parts in the "OK" Overshot. Then check these unique features . . .

THREE-SEGMENT SLIPS: Each bowl incorporates a unitized *three*-segment slip assembly that is flexibly mounted in the bowl. Not only does the three-segment design assure a more uniform grip *around* the fish, but since each segment is "unitized" in exact alignment with the other two by means of a spring steel band, the three segments move as a unit, *grip as a unit*. There is no risk of off-center wedging—no chance for one slip to set higher or lower than the others.

Result—*a uniform, full grip that will not slip or fail during recovery operations!*

And since each segment is "keyed" to the bowl so that the slips will not rotate within the body, torque can easily be applied to the fish, if desired, to facilitate recovery.

POSITIVE PACK-OFF: To permit full circulation through the tool, the "OK" Overshot incorporates a pack-off rubber positioned *below*—not above—the slip segments.

This feature not only permits maintaining a positive pack-off as long as the slips are engaged on the fish, but also assures the pack-off rubber making its seal a sufficient distance below the top of the fish to clear any distorted, out-of-round, or split pipe sections that may be present near the top portion of a twist-off. This, coupled with a separate pack-off for each bowl diameter, reduces to a minimum any risk of pack-off failures. *If you can grip the fish you can pack it off!*

And here's another important feature. Note that the pack-off rubber is held in place by a steel gland. This gland projects sufficiently beyond the internal diameter of the bowl to center the fish, thus protecting the pack-off rubber against abnormal compression as well as protecting the slips against damage from a misaligned fish. This gland can be either plain, as shown, or can be provided with a milling surface on its inside taper to smooth up minor, but troublesome burrs and rough edges on the top of the fish before it enters the packing rubber.

QUICK, FOOL-PROOF OPERATION

Operation of the "OK" Overshot is as simple and trouble-free as its design. Simply run the tool into the hole—either attached directly to the run-in string, or with a section of casing above it to permit gripping farther down the fish than normally. As the tool is lowered over the fish, the flexibly mounted slips expand to permit the pipe to enter the bowl. Then the run-in string is simply raised, whereupon the tapered slips, forced downward by the coil spring, *automatically* take a firm, uniform grip on the fish. *It's as simple as that—no complicated operations or setting procedures are necessary!*

Release—if desired—is equally positive. Merely let off strain on the run-in string, then rotate the string in a screwing direction as it is slowly raised. Since the slip wickers are cut in a spiral design (like a thread), continued rotation unscrews the tool from the fish for quick, complete release!

WIDE ADAPTABILITY TO VARYING REQUIREMENTS

The "OK" Overshot is readily adaptable to a wide range of operating requirements . . .

▶ **Two or more "OK" bowls are available connected together, as shown at left, for catching varying diameters. The bowl to fit the largest diameter is, of course, at the bottom—that to fit the smallest, at the top.**

▶ **Various types of top connections are available: (1) Short Type (overshot to drill pipe) . . . (2) Long Type with slip and elevator recess (overshot to drill pipe) . . . and (3) Regular Type (overshot to casing).**

▶ **Where extensive milling is necessary—more than that within the scope of the milling type packing gland—the Guide at the bottom of the tool can be replaced with a heavy-duty Milling Shoe.**

▶ **When the fish has fallen into a cavity in the side of the hole, the Guide can be replaced with a Wall Hook to catch and straighten the fish for easy engagement.**

▶ **When operating in a hole with a diameter considerably larger than the Overshot, an Oversize Guide can be substituted for the regular Guide to assist centering the fish into the tool.**

AVAILABLE IN A COMPLETE RANGE OF SIZES

the Baash-Ross "OK" Overshot can be used for recovering virtually any size of pipe that may become lost in the hole. See your nearby Baash-Ross representative for complete details—or write direct!

AVAILABLE THROUGH LEADING SUPPLY STORES

block and line clearance while raising the mast, and can be extended to various lengths. The extendable portion of the catwalk is designed to bend if struck by the block, thus avoiding possible damage to the platform. Sliding fingers prevent the racked pipe from falling out and keep the drilling lines from entering the racking area.

The 5-ft spacing of the mast leg girts, made possible by the strength of the welded joints, makes it simple to adjust the height of the stabbing board which rests on the inner side girts next to the rear face. The box column design of the mast legs simplifies lighting installation and provides inbuilt protection. Once strung, the lights may be left in place during moves.

Four "U" bolts attach the water table beams to the top of the mast. When loosened, these bolts serve as hinges so that the mast legs can be drawn together during moves. The two "X" brace stiffener trusses, one on each side, are situated just below the water table and provide additional mast rigidity.

The six-sheave crown block is equipped with the company's patented sheaves mounted on a single shaft. This type of mounting eliminates unnecessary weight and provides for better distribution of weight on the mast legs. Triple line guards prevent the drilling line from jumping the sheaves. The entire sheave cluster may be lowered to the floor when desired through a 39-in. by 76-in. top opening.

On the Ideco mast, no part of the crown or crow's nest extends past the ends of the water table beams. Thus, if required, a service gin pole of "A" frame design may be bolted into predrilled holes. Ample floor room is provided an all four sides of the sheave cluster, and is enclosed by welded steel safety rails.

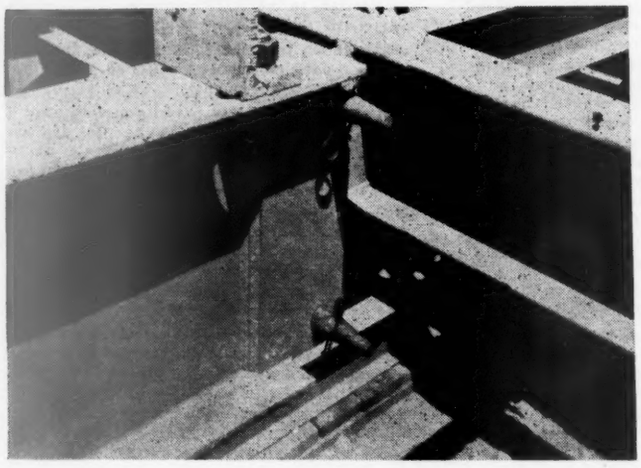
The ladders on the mast are hinged to fold against the mast for streamlining in transit, and the ladder steps provide ample toe clearance to meet safety regulations.

The 18-in. OD deadline anchor drum is fitted with a bronze bushed line clamp. It is mounted on the left main mast leg pedestal where it is in full view of the driller at all times. In this location, it is free from washdown water and rotary mud, and does not interfere with floor space. During erection of the mast, the deadline pulls directly off this drum without need of auxiliary guides. The weight indicator and mud pressure gages are placed just above the drum where they, too, are in full view of the driller.

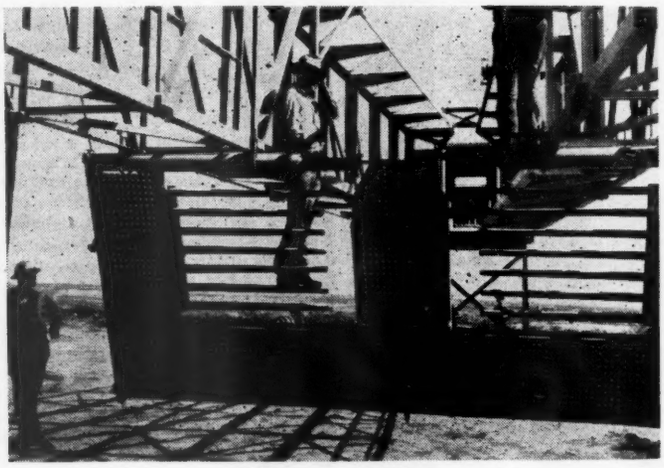
Several degrees of breakdown may be used in moving the mast, or the entire rig can be skidded between locations with the mast assembled and erect. The monolithic all-welded panels are a distinct advantage in this case as they provide exceptional rigidity. These same welded panels help localize breakdown joints so that a minimum of disassembly is accomplished when it is necessary to take the mast apart.

When it is not advisable to move the

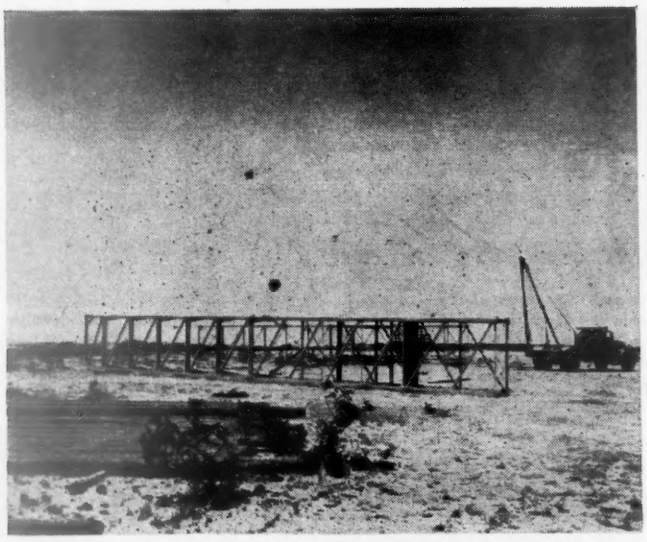
The full view mast's substructure is made up of twin box structures, each 7 ft 6 in. wide. The boxes are quickly assembled into a complete substructure with sledge pin connected members.



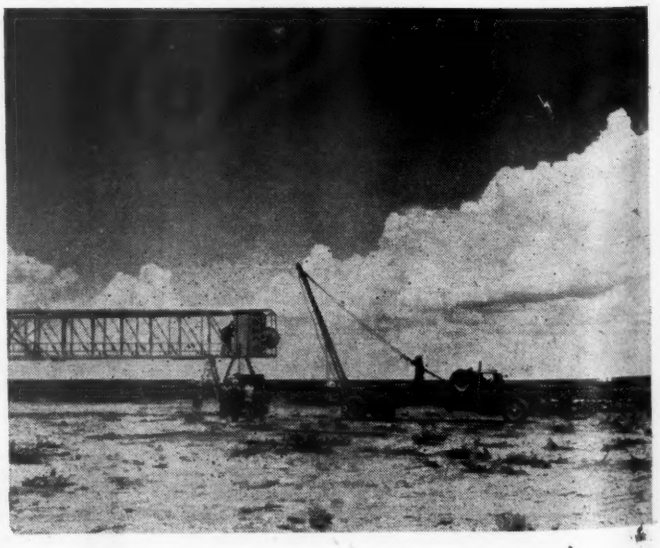
Twin racking rakes are designed to provide balanced racking. The platform and back strut are bolted at four points to the mast sections providing additional overall rigidity.



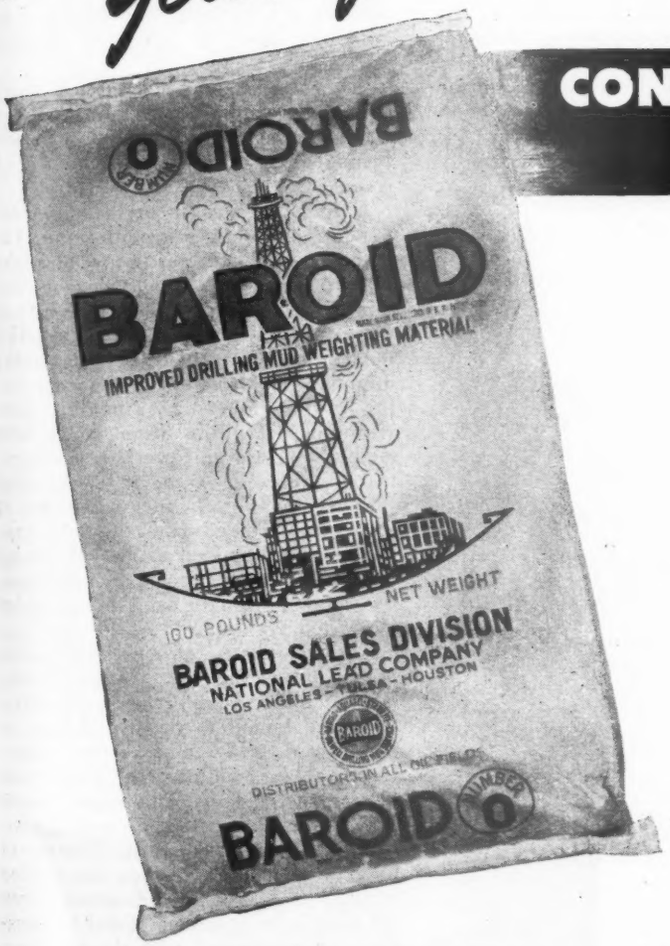
Main mast sections are of four sided box construction. This design provides extra rigidity over two section open faced box construction masts.



The six sheave crown is equipped with Ideco's 36 in. fabriform sheaves, all mounted on a single shaft. This design provides equalized leg loading and line pull.



CONSISTENTLY
the best weight material



500 DISTRIBUTION POINTS PUT BAROID WHERE YOU WANT IT WHEN YOU WANT IT

AND THERE ARE GOOD REASONS WHY!

Ever since 1925, when Baroid was first introduced, operators and drillers have found Baroid uniformly, *consistently*, tops in quality. The pure ground barytes in *every* sack in *every* batch meets the same high standards of fine grind, high specific gravity and freedom from impurities. Baroid consistently provides maximum weight with minimum viscosity.

HOW? BECAUSE...

Baroid Sales Division owns and operates the most extensive deposits of high-grade barytes, and the milling processes are supervised by trained metallurgists whose assignment is to make *every* sack of Baroid meet the highest standards of quality.

Baroid
BAROID SALES DIVISION
NATIONAL LEAD CO.
Los Angeles 12 . Tulsa 3 . Houston 2

COMPLETE DRILLING MUD SERVICE

mast in the erected position, it may be lowered to the horizontal, then moved intact with one end supported on a truck and the other on a dolly.

When highway transport is required, the mast may be moved in two sections. After removing the racking platform and the top column stiffener trusses and back strut, the two mast legs can be drawn together. The mast is then separated at the center intermediate sections and moved in two equal loads. Total road width when moving in this form is only 7 ft 10 in. When it is necessary to move the mast with shorter vehicles, it may be broken into four sections. In most cases, the traveling block can be left reeved and carried on top of the mast.

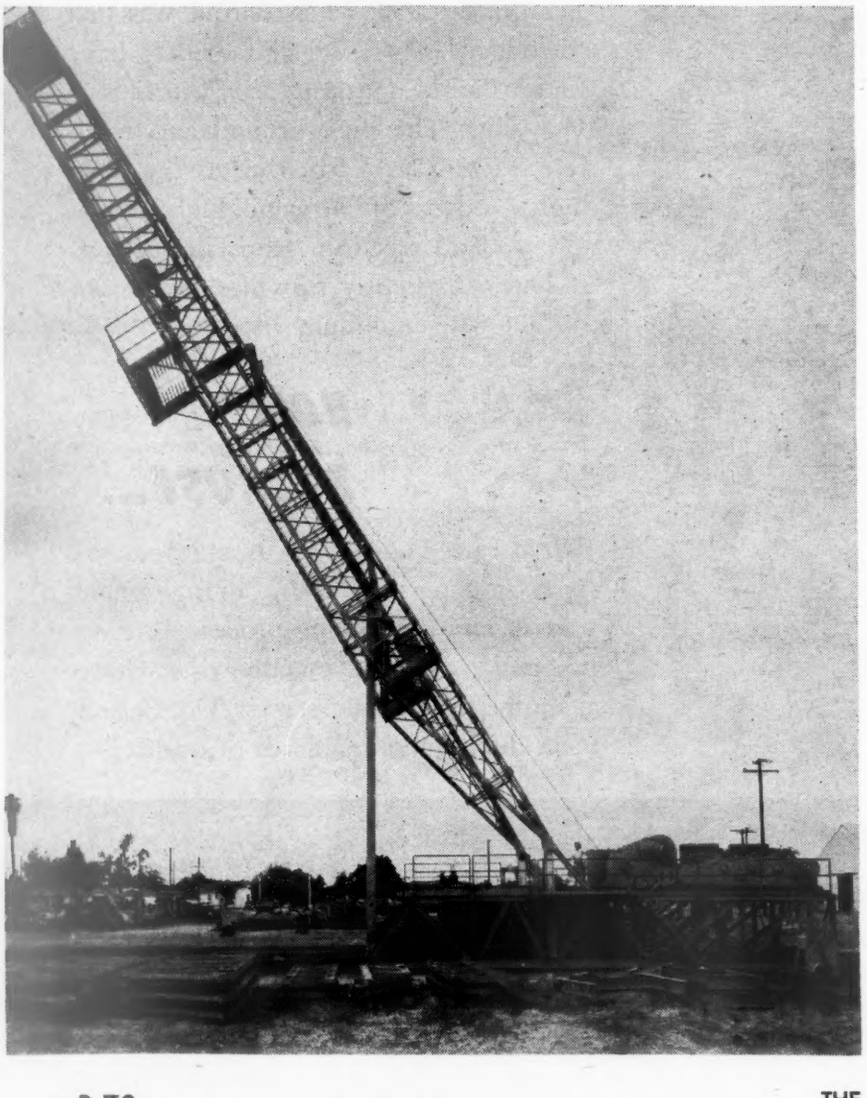
For transport overseas shipment, all bolted girts, diagonals, platforms, water tables, etc., are disassembled from the mast, leaving only the welded steel panels. The removed components are then nested in these welded panels to form packages panel-size and 8 to 12 in. thick. This feature vastly reduces volumetric shipping space requirements.

The use of welding and angle structural shapes throughout the Ideco mast eliminates entirely the need for gusset and stiffener plates. This is true, even at bolted joints, where the angle shape itself gives sufficient rigidity. The net result of gusset plate elimination is lighter weight and a consequent reduction of stress requirements all along the line (for raising, handling, windage, stability, etc.).

Standard commercial quality (not high strength) bolts are used in all bolted joints. C. F. Van Loozen, Ideco sales engineer, points out that this is a substantial safety factor. "When high strength bolts are used, then subsequently lost, they are too liable to be replaced by ordinary bolts, thus reducing bolted joint strength to a dangerous level," Van Loozen says.

The extensive use of welding in the new Ideco mast demanded the development of new fabrication techniques. Flat plates or aligned beams are used for mounting and positioning the weld components. The components are then tack welded together to form the assembly and hold it in shape. Next step is to finish weld.

Raising the Ideco mast to working position. Note absence of auxiliary raising equipment.



In some cases the panels must be turned and repositioned during finish welding. No overhead welding is attempted. Metal cleaning prior to welding is accomplished by sandblasting. All weld beads are given careful visual inspection after they are laid.

About 600 lb of Lincoln "Shield Arc No. 85" welding rod are consumed per mast. Welding time on each mast averages about 240 hours. Lincoln Electric Arc Welders are used to accomplish about 98 per cent of all welding work. No beveling or special joint preparation for welding is necessary.

Once fully tooled for production, the Ideco engineers are firm in the belief that it will be cheaper to produce the welded mast than a similar mast of bolted construction. About 40 of the new masts have been fabricated to date, with the first 20 going to overseas operators.

After the mast is completely fabricated, it receives an overall sandblast, a substantial coating of zinc chromate primer, followed by a spray paint finish coat.

The advantages inherent of welded mast construction are obvious. The monolithic structure of the welded joint is more rigid than a bolted joint, and minus the danger of loosened bolts or bolts missed or not properly installed during assembly. This increased rigidity minimizes deformation of the mast during raising, lowering or hauling. Less vibration (resulting from the greater rigidity) results in fewer stress concentrations and reduces the danger of metal fatigue. Another distinct advantage of monolithic welded construction is the end-fixation provided in the column leg angles and panel bracing that increases the column strength over that provided by bolted type structures.

The smoothness of the welded joint, minus protruding bolt heads and nuts, makes handling easier, as such protrusions are bound to catch and hook at unexpected and embarrassing times. Breakage or bending will often result from such accidents. This same smoothness makes for better overall appearance of the finished mast. Fixation of breakdown points between the welded sections is a distinct advantage when the mast is being disassembled by workmen not acquainted with the structure. It prevents unnecessary disassembly with consequent excessive reassembly time.

In general analysis it may be said that the new Ideco "Full View Mast" employs welding to the ultimate utility of the process without extending it to inconvenient proportions. Welding is used for every joint where weldment joining is practical. But when a bolted joint is more advantageous from the user's standpoint than the higher strength and rigidity of a welded joint, concessions are made accordingly.

This bears out the premise mentioned at the beginning of this article that efficient design is largely a matter of compromise to obtain maximum service results and customer satisfaction. ★★

Evaluation of Rotary Drilling Lines†

By following certain requirements, the industry in general can have reduction in drilling line costs

J. U. TEAGUE*

THE purpose of this paper is to discuss rotary drilling lines and how to get more service out of them. Many operators and contractors are reducing their drilling line costs and there is no reason why other contractors can not do equally well.

What they are doing is simple and easy to do. It requires mainly:

(1) Keep current and accurate service records on each line, preferably at the rig where the line is in use.
(2) Use longer lines and cut off short lengths at regular intervals.
(3) Use large diameter lines.
(4) Exercise care in handling and using wire lines as is recommended by the American Petroleum Institute, and wire lines manufacturers.

The cost of wire line has increased, as have all other supplies used by the drilling contractor, in recent years. In 1945 a 1⅛ in. line cost about 59c per foot, today it costs 67c, an increase of about 14 per cent. The trend toward deeper drilling has also increased wire line costs. A round trip from 5,000 ft deep with 4½ in. drill pipe, 120 ft of 6½ in. OD drill collars and a traveling block and hook weighing 14,000 lb, accumulates 67 ton miles of wire line service. A round trip from 10,000 ft deep with the same equipment accumulates 190 ton miles; and from 15,000 ft, 369 ton miles. So, 35 round trips from 10,000 ft would accumulate as much wire line service as 100 round trips from 5000 ft. It is especially important then, that the contractor engaged in deep drilling pay attention to his wire line costs.

Service Record

The most important prerequisite to good wire line service is a good service record. Most contractors do keep some sort of ton mile records on their drilling lines. If you are like most, the ton mile service obtained from a line is computed after the line has been replaced. This is probably done by going back through the daily drilling reports when you have a little spare time, counting the round trips made while the particular line was in service, then consulting the ton mile chart and arriving at a figure that represents the total service. If it seems too low, you make a mental note to demand an adjustment from the wire line manufacturer's representative or else threaten to quit using his particular line. This type of record keeping is probably better than none at all, but it won't do if you want to get the maximum service from your line. To do that, the ton mile service record on a line must be kept daily as the line is in use. You will see why this is so as we get further into this discussion. It is preferable to keep the service record on the line at the rig where the toolpusher can consult it daily. Various wire line manufacturers are providing simple charts and calculators with which the average toolpusher or driller can easily calculate the ton mile service on the line he is using.

Ton mile service does not reflect wear due to shock loads or other damage to the line by unusual conditions. Such damage might occur in very rough drilling, chasing drill pipe to unplug a bit, jarring while fishing, or heavy pulls made on stuck pipe. It is important that the toolpusher include, in his service record, notations of such operations. This will enable him to properly evaluate the service rendered by a drilling line.

Use of Long Drilling Lines

It has been well demonstrated that better wire line service is obtained by using lines long enough to string the maximum number of lines that will be required to drill the well and have enough excess to permit worn sections to be cut off the drum from time to time. In the past, a line 2500 ft long seemed to be the popular length for deep drilling. This has now been increased to 3500 ft and even to 5000 ft in some cases on deep wells in West Texas.

Even a haphazard program of cutting worn sections of the line off the drum seems to improve the service, but very great increases in service have been realized when a definite cutting off program has been followed. The best results have been obtained by cutting off a section each time the line accumulates a certain number of ton miles service. This is why it is important to keep the service record of the line at the rig. The amount of service that can be allowed between cuts is something the operator will have to determine by trial and error. There are so many variables on each individual rig, which affect wire line service, a fixed recommendation can not be made. The amount of line cut off should be such that points of concentrated wear will be changed. The worst wear occurs where the line turns back from the end of a wrap to start another wrap on the drum. Abnormal wear also occurs at the top of the crown block sheaves and the bottom of the traveling block sheaves at the points where loads are regularly picked up. If enough line is pulled through to put the turn-back point of one wrap at exactly the turn-back point of a lower wrap, or a pick-up point on one sheave exactly at the pick-up point of another, then certainly no benefit will result from cutting off a section.

It will be simple to avoid this if the toolpusher understands what he is doing. The field engineers of the wire line manufacturers will be glad to help the contractor work out a program of cutting off line for his particular rigs.

The best practice seems to be to make short cuts of around 35 ft to 60 ft at frequent intervals rather than longer cuts at longer intervals. One manufacturer who has been working with contractors using long lines on deep drilling recommends a cut of 30 ft to 60 ft at intervals of 800 to 1200 ton miles service. Another manufacturer who has given a great deal of study to this, has developed a simple chart to help select the proper length to cut off.

The use of a long line and frequent cut-offs is fine for increasing wire line service but there are other factors that must be considered before you go all out on such a program. It will not benefit the contractor to double the life of his line if he spends more in rig down time cutting off the line, or in extra costs due to hauling and handling the extra length of line, than the value of the line saved. For example, on barge rigs, the use of very long lines would present no transportation or handling problem, whereas on a rig that is moved every three weeks or so, transportation and handling might be a prohibitive factor. If the rig was dismantled each time it was moved, the length of line used would probably be limited by the capacity of the drawworks drum.

†Presented at the annual meeting, American Association of Oil Well Drilling Contractors, Fort Worth, Texas, September 24-25, 1951.
*President, Columbia Drilling Company, Houston, Texas.

All these factors must be weighed in arriving at the most beneficial program from an overall cost standpoint.

The time required to cut off the line can be reduced to a minimum by a study of the problem on the individual rig. Some contractors have provided means for hanging the block in the derrick instead of setting it down on the floor when pulling the line off the drum and through the sheaves to make the cut. Others recommend use of a grooved drum that will permit use of fewer wraps on the drum when the traveling block is in its lowered position, resulting in less line to be unspooled from the drum before the line is cut off. There are also patented dead line anchors that will permit faster release of the line than the U bolt wire line clamps ordinarily used. These anchors offer a further advantage in that they will not injure the line when it is clamped off like the U bolt clamps will.

An outstanding example of how wire line service can be increased is illustrated by a line installed on a barge rig by a major company. This line was carefully watched by both the manufacturer and the company. A rigid program of inspection was maintained and a cut off program of 15 ft to 35 ft after each 2000 ton miles of service was followed. The service record of this line was:

Depth of wells: 14,000 ft.
Area: South Louisiana.
Line: 1½ in. by 3500 ft 6 by 19 improved plow steel, right lay, independent wire rope center, performed rope.
Derrick: 184 ft high.
Number of lines: 10.
Final length of line: 2306 ft.
Total service: 95,000 ton miles.

This line ran a full year. A sample was taken from the worst part of the section cut off after 69,000 ton miles of service and it was found that the loss in tensile strength was only 4.2 per cent. A final sample, taken when the line was discarded, showed a decrease of 38 per cent of tensile strength. There were no outer wires broken on the first sample but on the final sample there were a number of the outer wires broken. This is significant in that not only was the ton miles service on the line increased but a line of virtually full strength was maintained until the very last.

This is a phenomenal record, an average of 27 ton miles per foot of rope. Records available on eleven 1⅛ in. thirty 1¼ in., and thirteen 1⅜ in. lines indicated an average of 4.4, 5.5, and 6.4 ton miles per foot of line, respectively. These lines were cut off at irregular intervals on the basis of visual inspection on all of the 1⅛ and 1⅜ in. lines. Only 4 per cent of the 1¼ in. lines were cut off on the basis of ton mile service. This comparison illustrates how service can be increased if definite program of care is followed.

Use of Larger Lines

One major company contacted reported that they were increasing their ton mile service by using larger diameter lines. Where they had been accustomed to using 1¼ in. lines, by changing to 1⅜ in. lines, they reduced the cost per ton mile of wire line service by one-half. They have realized better service from the larger diameter lines even when a definite cut off program was not followed. This company is still experimenting with this idea and, if it is found to be valid, the probable result will be a trend toward using larger lines, as well as a definite cut off program, for maximum service.

Discarding Lines

When is a line worn out and ready for replacement? The visual inspections given the line by the toolpusher or driller is probably as accurate as any. When he notices the outside wires on the line begin to break, the line will deteriorate very rapidly under further service. So, on that point, at least, we do not have to resort to the "scientific method." The preformed line has to be watched closer than the non-preformed line, for the wires on preformed lines will break and remain in position, whereas on the non-preformed line the wire will usually spring out or "wicker" as soon as it breaks. The toolpusher or driller inspecting the line should not mistake flattening or "peening" of the outside wires for badly worn wires. It is possible to flatten the outer wires due to working under heavy loads without actually reducing the cross sectional area of the steel or seriously impairing the strength of the line. If the line is inspected closely, it is possible to distinguish between the line on which the outer wires have been worn and one which is merely flattened from so-called "peening".

Rig personnel should be cautioned to inspect preformed and non-preformed lines very closely for broken wires when they approach the discard point. If they don't, the contractor may find himself with his drill pipe on bottom with a line so bad he doesn't dare pull out of the hole without changing it.

Choosing a Line

The contractor has a wide choice of sizes, types, and construction of wire lines available to him to fit his particular needs. It has long been the custom to choose a new line that will give a safety factor of 5 when the heaviest expected load is applied with the maximum number of lines strung.

The size of the line, and the grade of steel it is made from determine its strength. The average strengths of the lines most commonly used in rotary drilling are tabulated as follows:

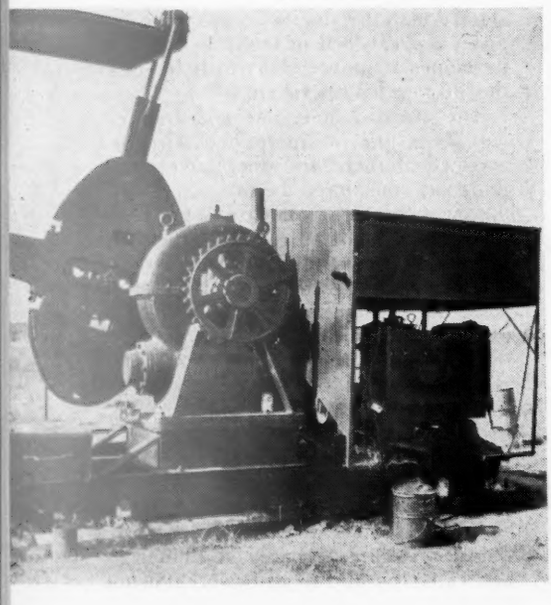
Size of line	Plow steel hemp center	Improved plow steel Hemp center	Improved plow steel Wire rope center
¾ in.	41,400 lb	47,600 lb	51,200 lb
1 in.	72,800 lb	83,600 lb	90,000 lb
1⅛ in	91,400 lb	105,200 lb	113,200 lb
1¼ in.	112,400 lb	129,200 lb	139,000 lb
1⅜ in.	135,000 lb	155,400 lb	167,000 lb

These strengths are for lines of 6 by 19 construction but they are approximately

FIELD AID

Provide Steel Housing for Pumping Engine

To protect the gas engine drive for a pumping unit and at the same time allow working space within the enclosure, one company welds a sheet steel shelter to the skid on which the engine is mounted.



On the side toward the pumping unit, to safeguard against possible oil spraying on the engine, the steel side is made solid, with only openings for the drive shaft and a small removable panel to give access to that side of the engine. The other three sides are welded in place for a distance of some 14 in. from the sloping top or roof, with additional covers for the other space being removable to give ventilation or working room at the engine.

In one corner of the enclosed upper portion of the housing is welded a tank in which lube oil for the engine is stored, a petcock at the corner allowing oil to be drained off as it is needed in the engine crankcase.

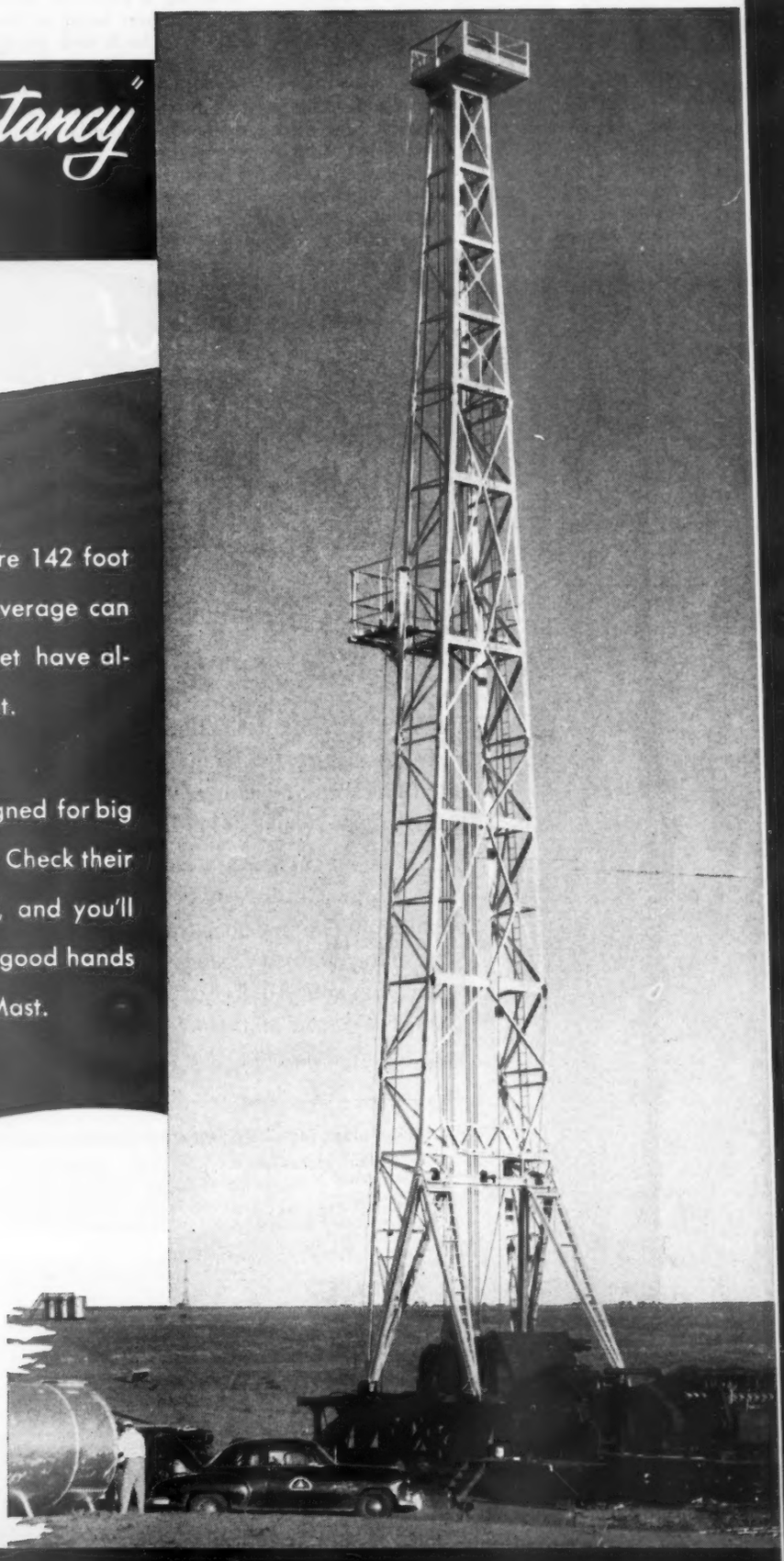
In addition to the stiffening afforded by the welded upper section, the corners are strengthened with ⅜-inch rods welded to the corner posts and to the lower edge of the part sheets.

The entire housing is removable by unbolting the lugs welded to the bottoms of the four corner posts and by dropping the part panel on the reduction gear side.—E.S.

WHAT IS THE "Depth Expectancy" OF A LEE C. Moore 142-FOOT MAST?

Experience in drilling with a Moore 142 foot mast shows that depths far below average can be reached. Wells below 15,500 feet have already been drilled with this big mast.

Lee C. Moore Big Masts are designed for big jobs. So far no job has been too big. Check their strength, ruggedness and durability, and you'll see why the toughest drilling job is in good hands when you use a Lee C. Moore Big Mast.



LEE C. MOORE CORPORATION

TULSA • DALLAS • HOUSTON • MIDLAND • SHREVEPORT • WICHITA • CENTRALIA • PITTSBURGH

Export Office — 9 Rockefeller Plaza, New York 20, N. Y.

correct for other type construction such as the 6 by 21.

The construction of a line determines its resistance to abrasive wear and its flexibility. The fewer number of wires, the more resistance the line has to abrasive wear and the less flexible it is. The more wires used in the construction of the line, the less resistant to abrasion it is and the more flexible. A 6 by 7 line would be highly resistant to abrasion but not very flexible. A 6 by 45 line would not stand abrasion but would be very flexible. The 6 by 19 line has seemed to be a happy medium for oil field rotary drilling lines and is nearly universally used, except on small rigs.

It is obvious that the least flexible line would be the most easily damaged by bending stresses and would require larger drum and sheave diameters for proper use. Excessive bending stresses will cause a line to fatigue and fail in a short while. An example of this, I'm sure most of you can remember, is breaking a piece of bailing wire. You made a short bend in the wire and reversed it back and forth rapidly. The wire broke. If you had made a long bend in the wire and reversed it back and forth, it would have been difficult to break. A similar thing occurs when you run a line over a sheave or around a drum that is too small.

The recommended sheave diameters for different rope construction are:

6 by 7	42 times rope diameter
6 by 19	30 times rope diameter
6 by 37	18 times rope diameter

The hemp center line is a cheaper line than one with an independent wire rope center. It is also more flexible and has the ability to cushion shocks imparted by sudden starts and stops. It does not have the ability to resist crushing like a line with the independent wire rope center. If the line to be used needs maximum strength for its size, and will be subjected to high compressive loads, the independent wire rope center line should be used.

The use of preformed or non-preformed lines is a matter of choice. The manufacturers claim the preformed line has less internal stress and is a superior line to the non-preformed. Certainly, the preformed is easier to handle, but, as to strength or service, there is little choice between the two.

The American Petroleum Institute's committee on wire lines now have the problem of the choice of a proper safety factor for wire lines under study. This committee may be able to make recommendations in the near future that will enable the contractor to realize greater economies in wire line cost.

For the small drilling or workover rig, several manufacturers are offering a 6 by 21 construction line in the 1 in. size. This line is giving very good service on small drums and sheaves where it will meet strength requirements. Operators of this size rig will do well to investigate these lines that are more flexible than the 6 by 19 construction normally use.

Care of Lines

Instructions for the proper care of lines in handling and spooling are so standardized and widely distributed that they will not be discussed in this paper. The contractor is referred to the API Standard No. 9A on wire lines or the handbook of any wire line manufacturer for these recommendations in detail. Suffice it to say that these instructions as to sheave sizes for various diameters of wire line, lubrication, periodic checking of sheave grooves for wear, proper dead line clamping, and spooling the wire line on the drum should be carefully followed. Special care should be taken of the excess rope when the extra long lines are used. The excess line should be kept on the shipping spool and reeled off as needed. The careless toolpusher who lets his excess line lie in the mud or be pulled up and tied to the side of the derrick is not going to realize full service from his longer line.

Acknowledgment

The author wishes to express his sincere thanks to Frank Tuxworth and T. H. Gibbs of Bethlehem Steel, R. D. McNutt of American Chain and Cable Company, and Joe A. Wilke, Jr., of E. H. Edwards Company, for their assistance and helpful criticism in the preparation of this paper.

* * *

GRANT REAMER CUTTERS are angled to the right. Therefore, the Reamer will not thread itself into tight hole, and assures desirable shearing-cutting action as well as round, full-gauge hole.

Now—you get *longer wearing life than ever before* with the Grant Reamer since all parts subject to wear are component parts of the cutter assemblies. Thus, simply changing cutter assemblies renews the entire tool. *No welding is required in the manufacture or maintenance of the Reamer body, eliminating the need for shop repairs.*

Proven Grant Tools—Used Where Performance Counts

Hydrostatic Bailers	Bulletin No. 11
Liner Pullers	Bulletin No. 14
Pressure Releases	Bulletin No. 15
Hydraulic Expansion Casing Scrapers	Bulletin No. 17
Rotary Underreamers	Bulletin No. 24
Cable Tool Underreamers	Bulletin No. 27
Hole Enlargers	Bulletin No. 38
Reamers	Bulletin No. 43-A
Hydrostatic Perforation Cleaners	Bulletin No. 50
Dump Bailers	Bulletin No. 51
Roller Cutter Shale Bits	Bulletin No. 54
Sand Pumps	Bulletin No. 55
Well Cleanout Procedures	Bulletin No. 57
Wall and Bottom Hole Scrapers	Bulletin No. 58
Vertical Casing Scrapers	Bulletin No. 59

Write for Descriptive Bulletins on these Grant Tools

GRANT OIL TOOL COMPANY
Subsidiary: MacClatchie Manufacturing Company

Main Office and Plant
2042 E. Vernon, Los Angeles 58, Calif.
Branches Throughout California and The Mid-Continent

Status of Russian Petroleum Industry

Geological prospect-drilling is five times as great as before World War II

In recent months the responsible heads of the Soviet petroleum industry, petroleum Minister Baibakov and his deputy Vice Minister Yevseyenko, were publishing reports in the Soviet daily press and in the technical periodicals, which, together with individual reports from the Soviet Union, supply an interesting if limited glance at the current situation in the Soviet petroleum industry. This is the report of the U. S. Bureau of Mines bulletin, International Petroleum Trade, May, 1951. If one separates the materially essential data from the surrounding often voluminous and politically slanted expressions, it is manifest that the Soviet Union with all the means at its disposal seeks to accelerate the goal of 436,000,000 bbl yearly, originally not contemplated until 1960. In the meantime, there is considerable distance from this goal. For the year 1950 reports from both Soviet and from foreign sources generally agree that the total production of the Soviet Union amounted to 273,200,000 bbl. Accordingly the planned figure of 257,200,000 bbl was exceeded according to Soviet statements by 16,000,000 bbl. At the same time, however, reference must be made to the fact that the production of 352,400,000 bbl that was hoped for in 1942, even before World War II, has not yet been attained. It may rather be determined that the Five-Year Plan of the post-war period estimates the increase of the Soviet petroleum production very cautiously.

In general it may be accepted that the old well-known Russian producing oil fields in the Caucasus are slowly losing their importance; and correspondingly the center of gravity of the new oil fields of the U.S.S.R., especially the fields of the so-called "Second Baku" (in the valley of the middle Volga and of its tributaries coming down from the Urals) is increasing. In 1950 only, from 50 to 60 per cent of the Soviet petroleum production came from the Caucasus, while the share of the so-called "eastern" producing fields has risen to between 40 and 50 per cent of the total. New centers of gravity of the Soviet petroleum production are chiefly the Bashkir and Tatar Soviet Republics (especially the Ufa territory with Tuizmasy and Ishimbayevo) and the Kuibyshev territory (especially Syzran).

The great increase in petroleum demand due to industrialization and the mechanization of agriculture compelled as early as 1947 a shortening of the planned periods of petroleum. The production-goal planned originally for 1950 was to be attained by the industry, as follows:

Kuibyshev in 3 years; Turkmenia, 3 years; Uzbekistan, 3 years; Baku area, 4 years; Grozny, 4 years; Maikop, 4 years; Bashkiria (Ufa), 4 years; Buguruslan, 4 years; Tata ria, 4 years; Saratov, 4 years; Kazakstan, 4 years, and Daghestan, 4 years.

These prescribed periods have been attained by only a few productive fields.

From the expressions of the acting Petroleum Minister Yevseyenko it appears that only the "Bashneft" (Ufa), the "Kuibyshevneft" (especially Syzran) and the "Turkmenneft" (Central Asiatic petroleum area) have already attained the 1949 plan-quota. The Baku area, still most important, in spite of all partial successes, has still not yet lived up to expectations. Even if the oil fields of Baku cannot yet be regarded as exhausted, here also—according to other Soviet sources—overproduction beyond the maximum efficient rate *(Raubbau)* in the last pre-war years and the war years has led to considerable flooding of the oil sands and to a diminution of the reservoir pressure, which had disadvantageous results on production. In the course of the intensive prospecting of the area individual prospect holes have been put down in Baku to depths ranging from 13,120 to 16,400 ft. On an average, wells drilled at Baku today reach a depth between 6560 and 9840 ft. The average current depth drilled at Baku (as in most other Soviet oil fields) has increased, especially since 1949. It amounted in 1948 at Baku to 4566 ft per rig, and rose in 1949 to 6337 meters, to increase further in 1950. Especially promising is the judgment of the oil accumulations discovered in even greater extent at Baku beneath the waters of the Caspian Sea. Development of these deposits has been begun and is said to have led to considerable results.

In the drilling in the area of the "Second Baku," which does not represent a closed industrial territory, the rocks have often shown themselves considerably harder than in the Caucasus. According to Baibakov, they attain in many places the hardness of crystalline rocks. Thereby the costs of drilling, among which the so-called "turbine drilling" (alleged to be a Soviet discovery) is utilized, are considerably higher than in the Caucasus.

On the costs of Soviet petroleum production an article in the Soviet periodical *Voprosy Economiki* gives information. According to this source, the costs of production in 1950 per metric ton of crude petroleum were 16.6 rubles in Baku; in the Kuibyshev territory (Syzran) 39.7 rubles; and in Bashkiria (Ufa territory) 24.1 rubles. In spite of the higher costs of production, the position of the Kuibyshev field (on the Volga), geographically well situated for traffic, offers a complete compensation for its high costs. As a result of costs of transportation, the price in Moscow for crude petroleum from Baku is 92.6 rubles per metric ton; from Syzran (Kuibyshev territory) is 66.7 rubles; and from the Ufa territory is 70.1 rubles. This price-relationship causes the administration of the U.S.S.R. to promote strongly the development of the "Second Baku," as well as in connection with the perilous situation of the Caucasian oil fields from a geopolitical standpoint. Even the State-directed economy must adjust itself to the costs of production and transport of the costly raw material.

Not only in prospecting, but also in drilling, transport, and refining the Soviet industry has tried to keep pace with the progress of foreign countries.

Geophysical methods of prospecting —seismic, geoelectric, etc.—are applied in the Soviet Union for the most part according to American models. Moreover efforts are made to develop their own methods. These works are officially led and promoted by the Union Petroleum Institute for Scientific Investigation and Geologic Prospecting in Moscow.

The building of apparatus and machines for the special requirements of the petroleum industry has shown a strong development, especially since 1948, under the leadership of the Soviet Ministry of Petroleum.

The capacity of the Soviet refineries has been enlarged; the cracking process has made considerable headway. As early as 1949, according to Baibakov, the refineries could attain an accomplishment that had originally been planned for 1950. The building of big refineries is reported, especially in the area of the "Second Baku," notably at Bensina and Potapovo near the oil-town of Oktyabrsk in the Ufa territory, and further at Dzerzhinsk on the Oka River.

The pipe line network has undergone a noteworthy extension. Today not only is Baku connected with Batum, but the Caucasian oil fields are also connected with the Donetz Basin and a series of fields of the "Second Baku" are connected with the refineries which lie along the rivers.

It is characteristic of the intensity of the Soviet efforts to increase petroleum production that geological prospect-drilling today shows a volume five times as great as before World War II. ★ ★

NEWS

Geological Engineering Department Accredited

The first curriculum in geophysical engineering ever to be accredited in any institution has been accredited at Saint Louis University Institute of Technology, the Very Rev. Paul C. Reinert, S. J., president, has announced.

This curriculum, along with the curricula in electrical engineering and geological engineering, have been accredited at Saint Louis University by the Engineer's Council for Professional Development, the overall accrediting agency for the engineering profession, Father Reinert said.

Saint Louis University was the first institution of higher learning in the world to establish a department of geophysics, in 1925. This department later became the department of geophysical engineering in the Institute of Technology.

Starworth Name Changed

Starworth Drilling Company has announced changing of its name to Blanton Drilling Company. W. N. Blanton, president, announced that no other changes have been made in the corporate charter, organization, stockholdings, or personnel. He added that all contracts, commitments, and obligations now existing between the Starworth Drilling Company and any other party shall continue in force and remain unaffected by this change in corporate name.

SSC Celebrates 20th Year

Seismograph Service Corporation, Tulsa, Oklahoma, recently celebrated its 20th anniversary this year. The company was formed in November, 1931, from an original investment of $4000, G. H. Westby, president of the company announced at the anniversary celebration. In connection with the 20-year event the company held its regular annual meeting. Principal honors of the meeting went to the only man in the organization who has been with the company since its inception, L. G. Cornish, in charge of the Midland, Texas, office.

Also honored was Harold L. Richardson, party chief, who was selected as the "Party Chief of the Year".

Navy Urged to Continue Alaskan Search for Oil

A committee appointed to advise the Secretary of the Navy on the Navy's program for exploration for oil in Naval Petroleum Reserve No. 4 (Alaska), has completed a series of meetings in the office of the director, Naval Petroleum Reserves. The committee has reviewed the results of the exploration during recent months, confirming the existence of an oil field at Umiat on the Colville River and the widespread existance of natural gas within the Naval Petroleum Reserve. The committee has also confirmed the presence of many untested prospects, and it concluded its session by recommending to the Secretary of the Navy a program for further exploration of this reserve during the years 1952 and 1953.

The exact size of the Umiat field cannot be determined on the basis of present knowledge, but informed estimates which were presented to the committee are in the range of 30, to 100,000,000 bbl within the presently known limits of the field.

Rotary Crank Developed

A new rotary crank has recently been placed on the market by the Happy Company, Tulsa, Oklahoma. The design has been tested and proved in actual field use and is exclusively incorporated on Happy pumping units under the trade name of Happy Adjustocrank.

The inward or outward movement of the weights on the Happy Adjustocrank is guided on a round steel bar which is anchored in the crank. Positive location of the weights is actuated with a long acme threaded screw arrangement that provides for any desired range of minutely sensitive rotary balance, including lead or lag balancing. One man with a lug type wrench, and a few minutes of time, can easily slack-off 4 clamping nuts, position two wing weights, and reset the 4 clamping nuts.

In the outermost position, the weights and crank of the Happy Adjustocrank clear the bottom plane of the 12 in. main skids, by 3 in. or more. Happy also takes advantage of natural or physical law in providing counter balance weights for installation on the integral walking beam extended rearward from the equalizer bearing.

Pennsylvania Motor Oils Are Known by Region

Individuality of Pennsylvania motor oils as the product of a distinct geographical region has been enhanced by court and federal agency decisions in recent months, it was reported by Fayette B. Dow of Washington, D. C., general counsel of the Pennsylvania Grade Crude Oil Association, and his associate, D. C. O'Hara. They told the Association's board of directors that it has been established anew by the courts and the Federal Trade Commission that only motor oils made from petroleum found exclusively in the Pennsylvania Grade region are entitled to use of the word "Pennsylvania," or any of its abbreviations or derivations and, secondly, that positive methods are available to identify Pennsylvania oils.

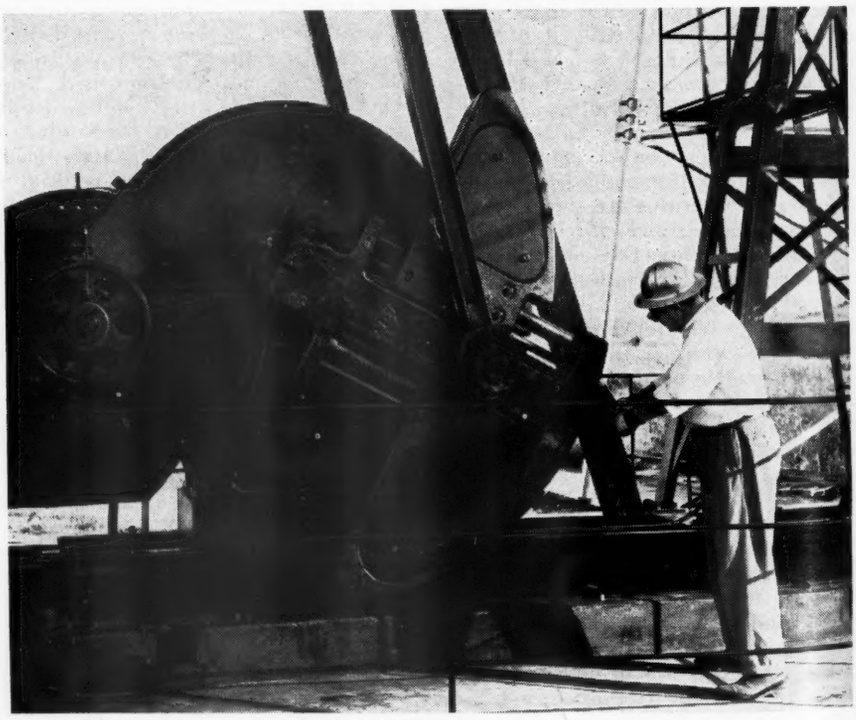
Deep Rock Moves to New Area Offices

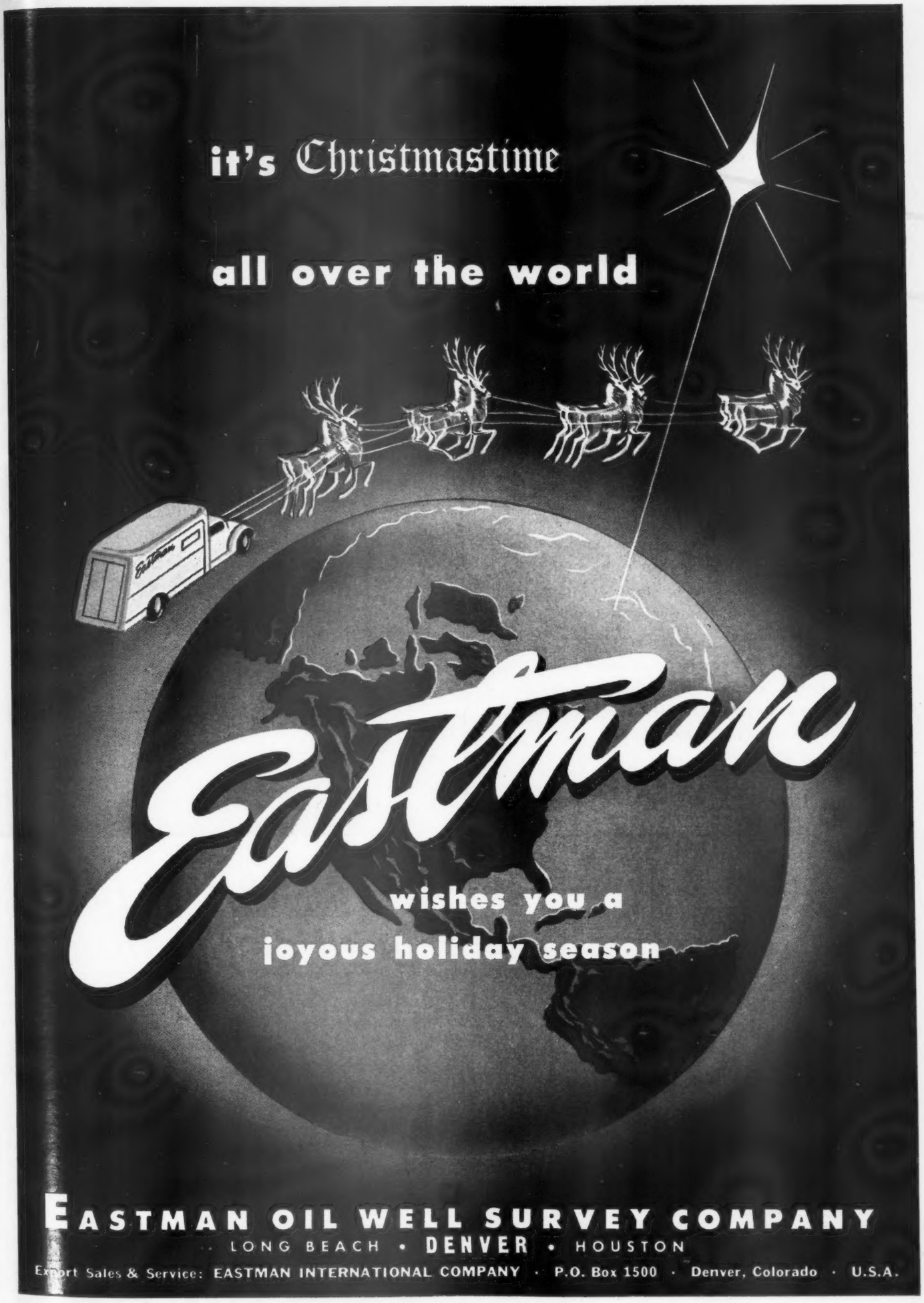
The area land and exploration office of Deep Rock Oil Corporation in Oklahoma City has moved into new quarters at 930 Apco Tower, John L. Ferguson, vice president, announced.

Deep Rock's Oklahoma City office is headed by L. L. Crozier, area landman, and O. E. Gram, area geologist. It was established only a few months ago in temporary quarters in the Braniff Building as a part of Deep Rock's expanded land and exploration program. Activities in Oklahoma, northern Arkansas, and the northern part of the Texas Panhandle will be covered.

Other land and exploration personnel in Oklahoma City include: C. D. Moore, assistant area geologist, R. W. Bayliss, scout, L. E. Villanyi, draftsman, and Veronica Burke, secretary.

New rotary crank developed by the Happy Company.





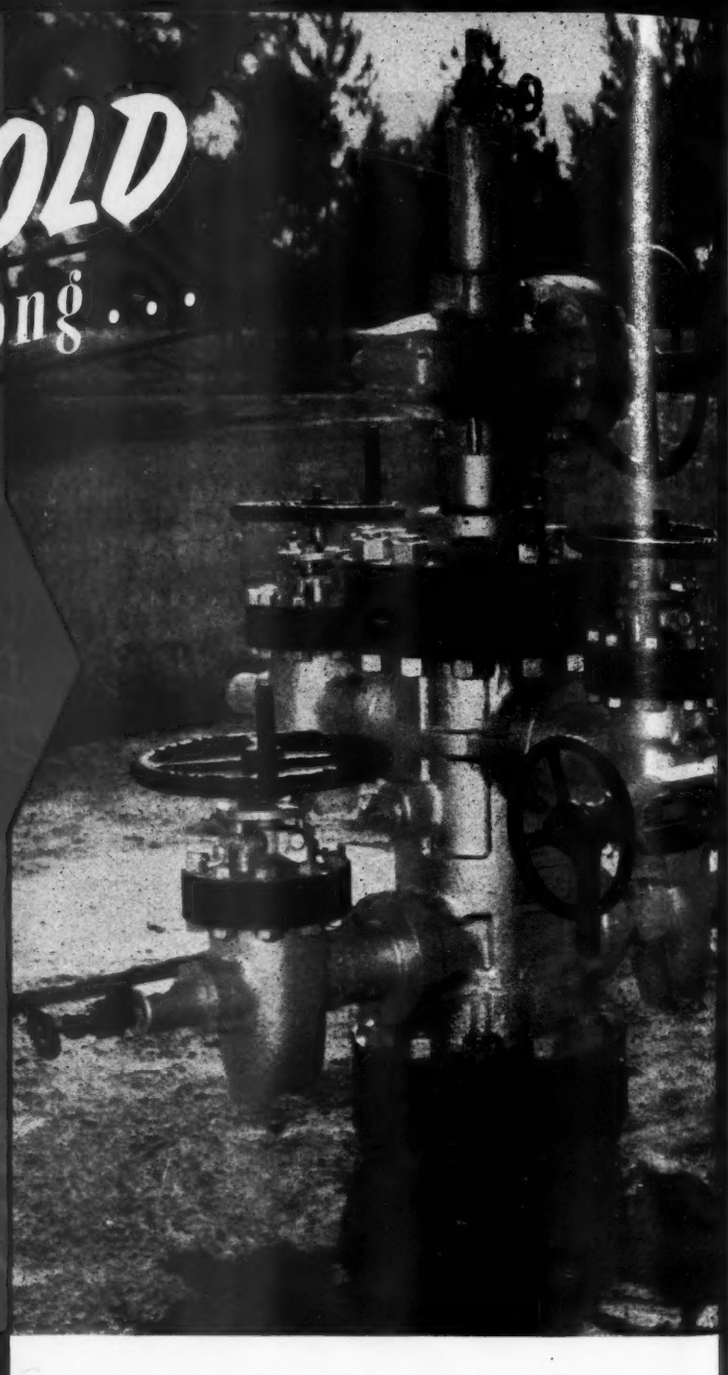
EASTMAN OIL WELL SURVEY COMPANY

LONG BEACH • DENVER • HOUSTON

Export Sales & Service: EASTMAN INTERNATIONAL COMPANY · P.O. Box 1500 · Denver, Colorado · U.S.A.

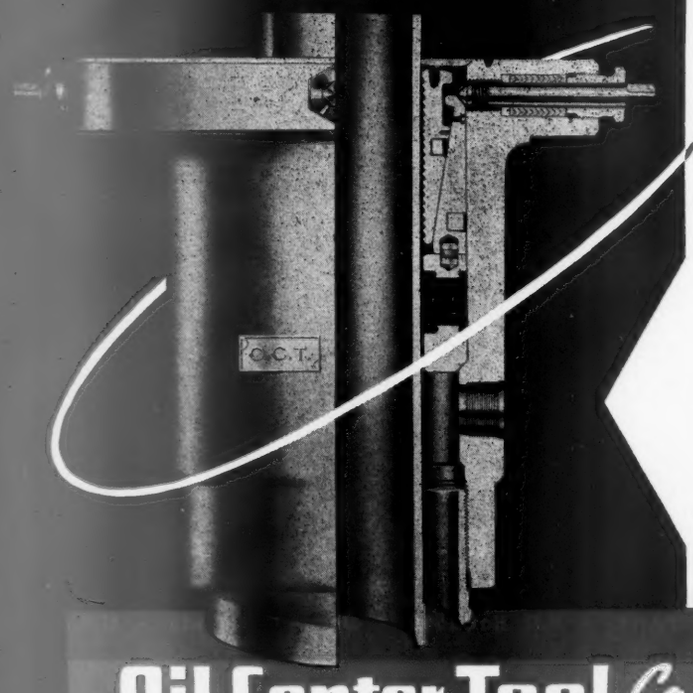
15 YEARS OLD
and still going strong . . .

NOT A SINGLE PIECE OF ORIGINAL EQUIPMENT HAS BEEN CHANGED OR REPAIRED ON THIS O-C-T ASSEMBLY



According to the record, this O-C-T 6000 lb. test assembly was nippled up on October 1, 1936. Tubing pressure at that time was 2900 lbs. Since then, the operator has had absolutely no maintenance or expense on the tree. The service given by this O-C-T Christmas tree is typical of that given by thousands of other O-C-T well head assemblies throughout the oilfields of the world.

Talk to your O-C-T representative about your well head assembly requirements. O-C-T products are always dependable and available through more than 700 conveniently located supply stores.



. . . and this is the head of the future

This is the O-C-T "C-19" Casing Head, the only casing head that meets every well completion condition with a single compact model.

Every man on the drilling-production team has good reason for liking the O-C-T "C-19" casing head. When dropped through preventers, suspension and seal are automatic. Thus, the "C-19" casing head eliminates open hole hazards. In addition, load capacity is twice as great as conventional slip hangers . . . slips set evenly and bite evenly . . . no field welding is required . . . hazardous installation work in muddy and cramped cellar space is reduced to a minimum and hours of valuable rig time are saved. Yes, it's true no other casing head gives you O-C-T flexibility and safety. Ask your O-C-T Representative for details.

Oil Center Tool Co.

P. O. BOX 3091 • HOUSTON, TEXAS

Export Representatives: Sterling Areas—Le Grand, Sutcliffe & Gell, Ltd., Southall, Middlesex, England. Address Export inquiries for All Other Countries to P. O. Box 3091, Houston 1, Texas.

Columbia Plans Expansion Of Engineering Department

With the nation's need for more and better-trained engineers becoming increasingly critical, Columbia University has announced detailed plans for a $22,150,000 engineering center program based on a new design for education and research developed around its world-famous school of engineering.

The program was made public by Dr. John R. Dunning, dean of engineering, acting on behalf of President Dwight D. Eisenhower and the University's trustees.

Besides the engineering school, described as the "hard core" of the new engineering center design, the plans provide for an Institute of Advanced Engineering science and a division of cooperative research in engineering that will work with industry on problems having educational value.

Of the $22,150,000 required to put the engineering center program into effect, Dean Dunning stated, $13,650,000 is being sought immediately to provide buildings and equipment, and $8,500,000 will be required subsequently for professorships, fellowships, and scholarships.

The first unit, an existing four-story building, has been acquired and is now being remodelled and occupied as it becomes ready. The second unit, a building of some 250,000 sq ft, rising 14 stories in the air, will be erected as soon as funds are available, the aim being completion no later than 1954, the University's bicentennial anniversary.

The expansion is expected to give advantages which will attract world scholars and scientists for advanced studies and research. The two buildings will more than double the present space available at Columbia for engineering training. Voorhees, Walker, Foley, and Smith are the architects.

Saudi Arabian Output Up....

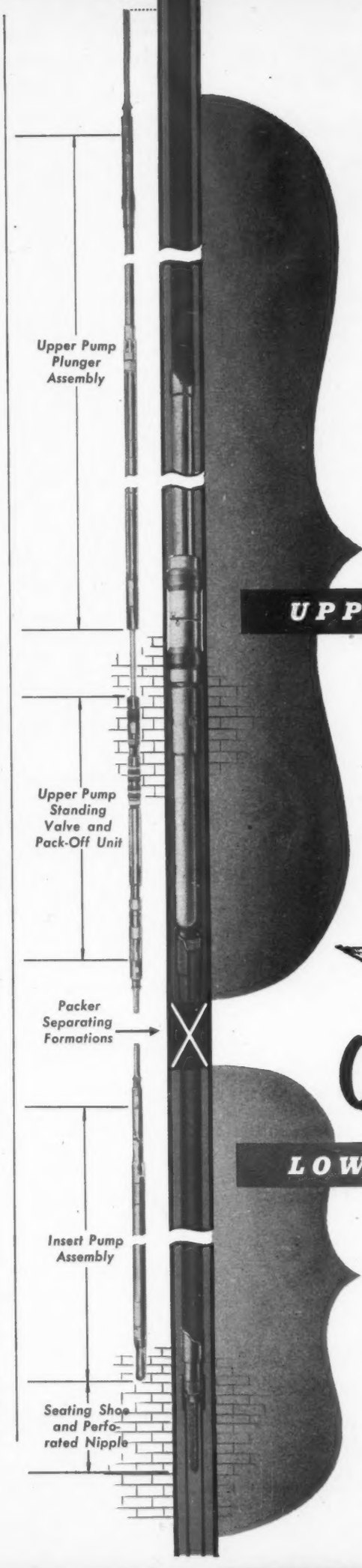
Crude oil production in Saudi Arabia during October amounted to 26,290,361 bbl, or an average 848,076 bbl per calendar day, it was announced by the Arabian American Oil Company. This is slightly above September output of 25,412,024 bbl or an average of 847,067 bbl per calendar day.

Crude oil production for the first 10 months of 1951 amounted to 224,593,896 bbl, an average of 738,796 bbl per calendar day.

OU Geology School Holds Celebration

The Oklahoma University school of geology celebrated its golden anniversary recently, dedicating a new $1,200,000 building. Speaker at the celebration was W. B. Heroy, Dallas, Texas, geologist, and vice president of the Geotechnical Corporation.

The new building is named in honor of the late Dr. Charles N. Gould, pioneer Oklahoma geologist who founded the school as a faculty of one in 1901.


Upper Pump Plunger Assembly
Upper Pump Standing Valve and Pack-Off Unit
Packer Separating Formations
Insert Pump Assembly
Seating Shoe and Perforated Nipple

THE OTIS TWO-ZONE PUMP for dually-completed wells is an assembly of two sub-surface pumps which operate simultaneously on a single sucker rod string. The pumps work in conjunction with a pack-off unit in a special cross-over packer to produce the upper zone through the tubing and the lower zone separately through the tubing-casing annulus. The pump assembly illustrated (Type C) consists of a tubing pump to produce the upper zone and a rod (insert) pump for the lower zone. Both formations are pumped in the conventional manner, the same as in a single-zone well, and at no time do the fluids commingle. Operation of the second pump does not require an additional pumping unit, stuffing box, polished rod, or special surface fittings, nor does it increase the rod and engine load appreciably.

Pumping two-zone wells with this equipment is practicable and profitable because there are no complex production principles or costly maintenance problems. During the past few years, a large number of these pump assemblies have been installed in many different types of dually-completed wells throughout the Mid-Continent area.

If you plan to complete a well in a two-zone field, or if you have a dually-completed well about to go on the pump, ask your nearest Otis office for our newly-published bulletin on the Otis Two-Zone Pump. In it you will find operating and design information, and a full explanation of the application of the Otis method of pumping two oil pays from a single well bore. Get your copy today; there is no obligation, of course.

UPPER ZONE

don't take one -TAKE TWO!

pump this second oil well separately and simultaneously through the same well bore

Otis TWO-ZONE PUMP

LOWER ZONE

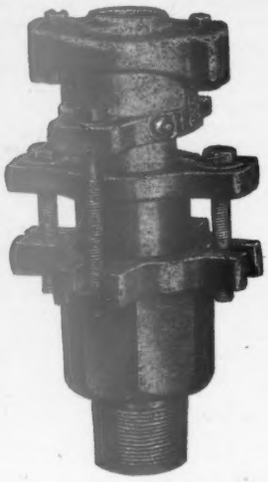
DALLAS • HOUSTON
ODESSA • CORPUS CHRISTI
VICTORIA • FALFURRIAS
LONGVIEW • NEW IBERIA
HOUMA • SHREVEPORT
OKLA. CITY • ELK CITY

PRESSURE CONTROL OTIS SERVICE - EQUIPMENT

OTIS PRESSURE CONTROL, Inc.

6612 Denton Dr. • Box 7206 • TWX DL-220 • Dallas

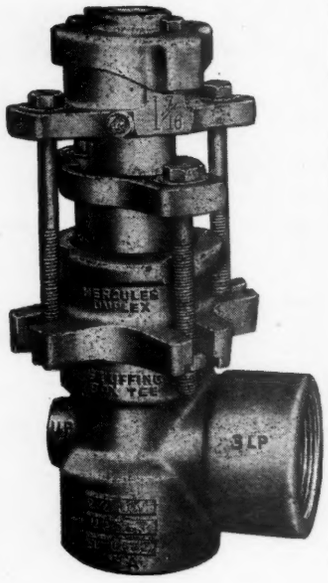
Hercules Red Tools
"Designed to Stand Out
Built to Stand Up"

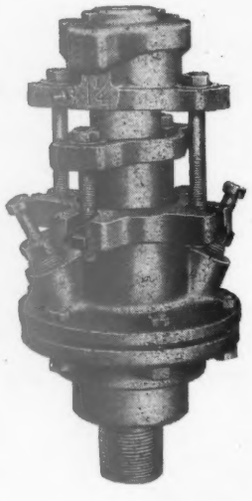


All Hercules Duplex Polished Rod Stuffing Boxes are Cone Packed for longest possible life and greatest economy. Illustrated (left) is Regular Type. Write for Bulletin 120-SB.

The Tee-Base Type Combination Stuffing Box and Tee (directly below) have been proven by years of service and savings to producers. Write for Bulletin 121-SBT.

A double packed Stuffing Box for use under most adverse pumping and flowing conditions (below). Be sure to order Type A-123-SBDP.





For greater savings, replace old style Upper Glands with the New Hercules Lubricating Upper Gland, as shown on Stuffing Boxes Illustrated.

SOLD AT ALL SUPPLY STORES

Export Representative:
OIL FIELD EQUIPMENT CO., INC.
T. E. WARD, *President*
30 Church St., New York 7, N. Y.

HERCULES TOOL COMPANY
Manufacturers of Oil Field Equipment
General Office and Plant: 17th and Phoenix P. O. Box 286 — TULSA, OKLAHOMA — Telephone 3-1186 Cable Address "HERTOCO"

Warren Petroleum Buys Devonian Stock

Warren Petroleum Company has acquired the Devonian Company of Tulsa, Oklahoma, as a wholly owned producing subsidiary. Several changes were also made in the officers and directors of both that company and Warren Oil Corporation another subsidiary, according to W. K. Warren, president of Warren Petroleum.

D. L. Connelly, Houston, president of Warren Oil has been elected board chairman of the Devonion Company, and E. S. Calvert of Tulsa has been re-elected president and a director and has been named a vice president and director of Warren Oil.

H. F. Beardmore and P. L. Lyons, vice presidents and directors of Warren Oil, were elected vice presidents and directors of Devonian. J. F. Anderson, Houston, has been named director of Warren Oil and Devonian in charge of exploration. Harry Dean, Tulsa, has been re-elected secretary and treasurer of Devonian.

Warren also announced that the two producing subsidiaries will be operated as separate companies, but the producing and drilling activities will be consolidated, with Beardmore in charge of the southern division, and Calvert in charge of the northern division.

Magnolia Gets Off-Shore Drilling Permit

A permit for drilling an oil well in the Gulf of Mexico off the coast of Louisiana has been granted by the Interior Department, according to Mastin G. White, department solicitor. Magnolia Petroleum Company has been given authority to drill an additional well in the Eugene Island area.

White reported that the authority was granted on recommendation of the U. S. Geological Survey that another well at that location is desirable from the standpoint of conservation.

White added that although the question of administration of off-shore oil lands is still unsettled, he acted on a 1941 opinion of Attorney General Robert H. Jackson, now a Supreme Court justice, that the secretary of the Interior has broad general authority to conserve natural resources whether on public or private lands.

Texas Group Buys Bonanza Oil

An independent Texas group is making plans for acquiring the Bonanza Oil Company, which brought in its first well in Montana less than a year ago, according to Bonanza's president, Dr. Victor Ziegler. The Texas group is headed by Leland Fikes of Dallas.

The Bonanza Company now has 10 wells in the field, all of them flowing wells and capable of producing 25,000 to 30,000 bbl of oil a day, Ziegler reported. Former geology professor. Dr. Ziegler developed the Bonanza field a few miles north of Worland, Wyoming, near the southern edge of Big Horn County.

Pakistan Test Well in Baluchistan Will Be Drilled to 10,000 Ft

Pakistan Petroleum's test well at Sui (Dera Bugti) in Baluchistan reached a depth of 1029 ft recently.

First stage of drilling operations in search for oil was successfully passed by lining the hole at a depth of 439 ft, with a 16 in. steel pipe to prevent caving of the sides of the well. This conductor pipe also forms the anchor for the blowout preventers that are installed at the surface to provide means for the control of well pressures.

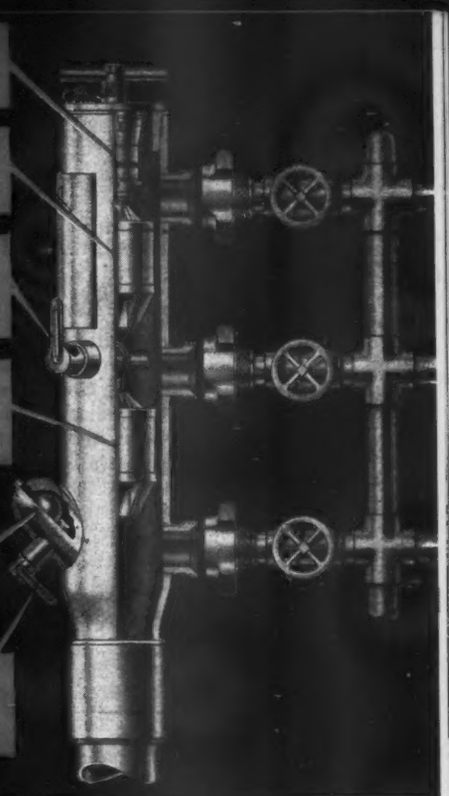
Drilling at the well has been resumed in 14¾ in. diameter hole.

The formations so far met have been soft sandstones. One twist off of the drilling string occurred but the piece of drill pipe lost in the hole was quickly recovered without any difficulty.

Pakistan Petroleum Limited began drilling operations in the uninhabited sandy desert of Sui in October. Three shifts of drillers, under supervision of R. J. Wilson, the driller-in-charge, with 24 years of experience in drilling, are working day and night to expedite drilling.

Even if oil is not found, this well will be drilling to a maximum depth of 10,000 ft. Pakistan Petroleum reported.

From HEAD to SHOE


Back pressure valve connected to top plug.
Top plug rides cement column down the casing.
Plug bar releases bottom plug without shutting down or opening head.
Bottom plug leads cement column and wipes casing clean of mud.
Trip ball - that ejects float assembly in shoe to provide full casing-bore discharge.
Ball dropper releases trip ball without opening head.

RECTOR FULBORE CEMENTING METHOD

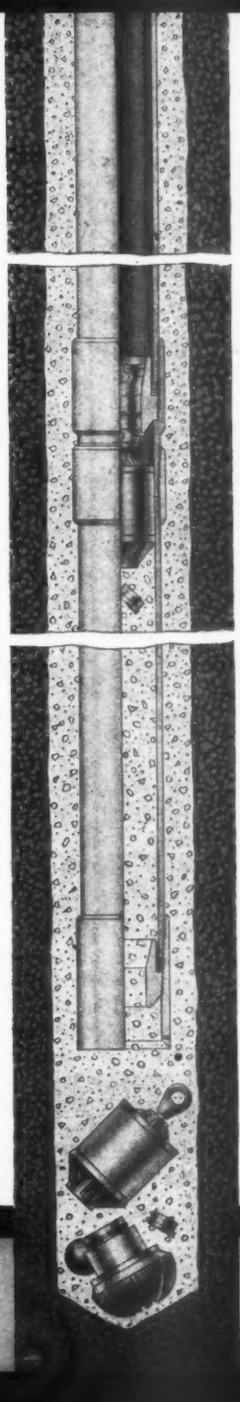
prevents contamination of cement

Every operator knows that voids caused by air pockets in the cementing string or soft spots due to contamination are the perfect set-up for future trouble. Prevention of these weaknesses is the basis of "Fulbore" cementing superiority . . . the assurance of a master cementing job, everytime.

The "Fulbore" multiple inlet head provides a closed circuit from beginning to end of cementing operations. The two plugs, made up in the head before it is connected to the casing string, are released mechanically without downtime. the plugs completely and effectively segregate the cement from the time it enters the head until discharged at the shoe. There is no possibility of contamination or the formation of air pockets.

Extreme simplicity is another advantage of "Fulbore" cementing. There are no discs to break . . . no small orifices through which the cement must be pumped. Traveling ahead of the cement, the bottom plug is pumped out of the casing through the float shoe from which the float assembly has been ejected after cementing string has been floated into position. This provides full casing discharge capacity . . . reduces the load on the pumps . . . permits greater volume to be circulated with same pump discharge pressure . . . results in higher velocity in space between casing and bottom of hole.

Every phase of "Fulbore" cementing is planned to make every job a master cementing job. Ask your Rector Representative or authorized supply store for full information about "Fulbore" Cementing and equipment.



RECTOR WELL EQUIPMENT COMPANY INC

★ MAKING THE OIL INDUSTRY SAFER ★

700 NORTH COMMERCE ST. FORT WORTH, TEXAS

Houston Plant: 2215 Commerce St.

REPRESENTATIVES IN ALL ACTIVE FIELDS

ASSOCIATION OF WELL HEAD EQUIPMENT MANUFACTURERS CERTIFIED

RECTORHEAD RECTOR FULBORE CEMENTING METHOD RECTORSEAL

WHAT'S DOING IN DRILLING

Canyon Reef Strike Made

An important new well has been discovered in the Aspermont Lake pool in West Texas. The Canyon Reef oil strike, Continental Oil Company's No. 1-A Scoggins, is situated 5 miles southeast of Aspermont, in Stonewall County. On completion the test flowed 440 bbl of 42 gravity oil in 5¼ hours through ½-in. choke at the daily rate of 2015 bbl. Gas-oil ratio was 953 to 1. Drilled to a total depth of 4925 ft, the well flowed from Canyon Reef lime through perforations at 4910 to 4918 ft.

Ashland Well Extends Texas' Spraberry Field

Ashland Oil and Refining Company has extended the Driver-Spraberry field, Midland County, West Texas, 1½ miles southeast. Extension well is the company's No. 3-46 Davenport, recently completed for a 24-hour flowing potential of 1121.76 bbl of 37.1 gravity oil, no water. Gas-oil ratio was 948.1.

Total depth of the well is 7050 ft. Production is through a ½-in. choke from open hole between 6912 ft, where 7-in. casing has been cemented. Tubing pressure is 185 lb, with packer on casing.

West Texas Well Given 1718 Bbl a Day Potential

A new well has been completed in the Wilshire (Ellenburger) field of Upton County, West Texas by Sinclair Oil and Gas Company. It is the Company's No. 2 R. S. Windham, which has been given a flowing potential of 1718 bbl a day of 43.2 gravity oil. Production is through perforations between 12,344 and 12,444 ft.

Maguire Completes Well

Russell Maguire has completed his No. 1 Palmer in Major County, Oklahoma. Flowing from the Manning sand, the new well flowed 236 bbl of oil in 24 hours on a ¼-in. choke. It was producing from perforations between 6836-74 ft and between 6879-92 ft.

Oklahoma Well Flowing 250-300 Bbl of Oil Per Day

A new well regarded as being good for between 250 to 300 bbl a day has been completed in Cleveland County, Oklahoma. It is Mid-Continent Petroleum Corporation's No. 1 Westermier, which has been drilled to a total depth of 9605 ft. On a drillstem test between 9580-9605 ft, and with tool open one and one-half hours, recovery was 5500 ft of 40 gravity oil and 100 ft of oil and gas-cut mud were recovered. Bottom hole pressure was 3850 lb.

Cotton Valley Field Well

With completion of the A. J. Hodges Industries No. 1 Pardee et al unit, the Cotton Valley field of Webster Parish, Louisiana, has been extended more than a mile west. The new well, which is a gas and distillate producer from the Davis sand, extends the field into Bossier Parish. Two miles from the Davis sand limits of Cotton Valley, the well is also three miles from the nearest Davis sand well. Production is from perforations at 8860-74 ft. Total depth of the well is 9550 ft and 5½-in. casing set to 8950 ft.

Humble Well Producing From New Oil Horizon

A new producing area is believed discovered in the Ham-Gossett field of Kaufmann County, Texas. A new well, Humble Oil and Refining Company's No. 2-B Annie Mae Tuggle, has been completed in the Lewisville zone of the Woodbine. The well flowed 105 bbl of 37 deg gravity oil through 9/64-in. choke. This field has 10 other producing horizons ranging from the Woodbine to the Rodessa.

California Pool Widened

The Texas Company is believed to have extended the newly developed North Arvin, California, with its No. 1 Kern Valley. Situated on the southeast side of San Joaquin Valley, the well was drilled to 6462 ft. The hole has been plugged back to 6320 ft, where 5½ in. casing was landed.

Oil Well Drilled In Texas Gas Field

The Chicago Corporation has drilled a new oil well in the new El Javali gas field, Starr County, Texas. The well is the company's No. B-2 Bessie H. Cooke, which pumped 19 bbl of 31.8 gravity oil daily from perforations at 2325-23 ft. Hole is bottomed at 2388 ft and has 5½-in. casing set at 2377 ft.

Third Producing Zone Hit In Suderbruch Oil Field

A third producing horizon has been discovered in the Suderbruch field at the Suderbruch No. 2. The field, which is owned by Gewerkschaft Brititta and Deutsche Vacuum Oel AG, has opened a third producing oil horizon in the Gigas formation of the Upper Jurrasic. Further tests in the White Jurassic formation will be made to determine the importance of the area.

North Sea Island Tested

A 6500-ft test has been begun on the small island of Helmsand in the Meldorfer Bucht, North Sea by Deutsche Erdol-AG. The well is aimed at the reservoir beds of the rhaetic west of the Heide saltdonie structure. A previous well, Meldorf 92 showed several traces of oil after reaching the reservoir bed.

Shell Well Flows 343 Bbl Oil on Test

Shell Oil Company's No. 2 Kelley "C" in Beckham County, Oklahoma, flowed 343 bbl of 59 gravity condensate on a recent drillstem test. Plugged back depth of the well is 9640 ft. In 10¼ hours the well flowed 343 bbl of oil through ⅜-in. bottom and ½ in. top chokes with a gas oil ratio of 7051 to 1. Recovery was 155 ft of oil, and no water.

Tide Water Completes Two California Wells

Tide Water Associated Oil Company, Western division, has announced successful completion of two wells, Ventura Avenue field, California; Lloyd Well No. 166 flowing at the daily rate of 691 bbl net of 34.2 gravity oil. Total depth is 10,645 ft. The V. L. and W. Well No. 33 is flowing at the rate of 599 bbl net oil per day, gravity 32.1. Total depth is 10,660 ft.

Rotary Rigs Operating in Oil Fields of United States and Canada*

Weeks	Total	Gulf Coast	Pacific Coast	Illinois Oklahoma Kansas	Arkansas Louisiana Texas	Rocky Mtn. Canada	New Mexico West Texas
(September)							
Third	2898	595	186	627	176	342	972
Fourth	2963	592	188	677	199	342	991
(October)							
First	2948	599	180	669	164	...	...
Second	2993	601	178	684	172	366	992
Third	3043	617	185	690	171	374	1006
Fourth	3083	630	180	683	181	368	1041
Fifth	3041	623	175	683	184	348	1028
(November)							
First	3070	646	171	672	188	348	1045
Second	3030	658	176	828	184	345	1039

* As reported to the American Association of Oilwell Drilling Contractors by Hughes Tool Company.

NOW IT CAN BE TOLD

GLOBE

"2-CUTTER"
INTEGRAL

JET ROCK BITS

Globe Jet Rock Bits are made in all popular sizes from 8½" to 15" in types SS2C, S2C, M2C, MH2C, and H2C.

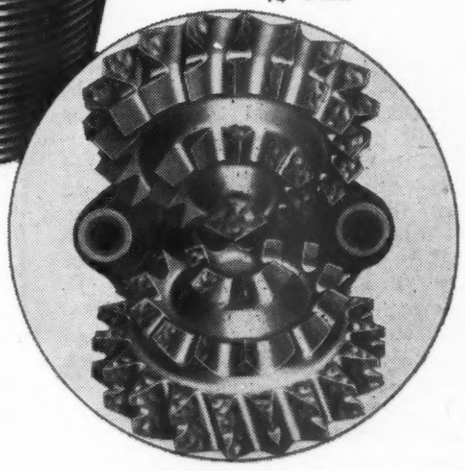
Perfected after 2 years of field testing

Now, after two years continuous development work, Globe proudly presents their complete line of "2-Cutter" Integral Jet Rock Bits . . . engineered and designed for the extremely high pressures of jet drilling . . . performance proved in all formations.

Always a leader, Globe pioneered the development of the integral jet principle. Everywhere, the results have been the same, regardless of formation . . . hole is completed in much less time with a far less number of drilling bits . . . a real savings in drilling costs.

Get factual information on these revolutionary new jet bits now . . . available from your nearest Globe representative.

Jet nozzles are placed for maximum penetration • proper bottom hole impact • thorough hole and bit cleaning • made of Tungsten-Carbide in 9/16", 5/8", 11/16" and 3/4" sizes.



GLOBE
OIL TOOLS COMPANY
GLOBE OIL TOOLS
Serving the Petroleum Industry with the Best in Drilling Equipment

Branches In: BAKERSFIELD AND VENTURA, CALIFORNIA • CASPER, WYOMING • DALLAS, HOUSTON, ODESSA AND TYLER, TEXAS • DUNCAN, OKLAHOMA • LAKE CHARLES, LOUISIANA.

Main Office and Plant:
LOS NIETOS, CALIFORNIA

Shell Well Drilled in Jefferson County, Texas

A new well has been drilled in Clam Lake field, Jefferson County, Texas, at Shell Oil Company's No. 24 McFaddin Trust, Sarah A. Pace Survey. From perforations at 4752-60 ft, the well flowed 173 bbl of 28 deg gravity oil daily through 9/64-in. choke. Tubing pressure on potential test registered 650 psi, and casing pressure 775 psi. This last well made eight horizons developed in Clam Lake, ranging in depths from 2350 to 6650 ft.

Kentucky Field Extended

George Huffman and associates have extended the recently opened Baskett area 4 miles northeast of Henderson in Henderson County, Kentucky. The well is the No. 1 Rash heirs, which is completing in O'Hara lime at 2362-72 ft. Production was gaged at 1230 bbl during the first 24 hours, and 830 bbl the second. The well was later reported flowing at an average rate of 14 bbl per hour.

Magnolia Adds Well To Mississippi Field

Magnolia Petroleum Company has completed a good producer in the Wayside field, Adams County, Mississippi. Final completion on the company's No. 1 Netterville-Kendall Unit has been made, giving the well a potential for 160 bbl of 42-deg gravity oil daily through 1/64-in. choke. Tubing pressure was 375 psi, and casing pressure 450 psi. Electric log and side-wall cores indicated 7 ft of oil sand in the one from which the well was completed.

Midco Oil Producer Flows 214 Bbl of Oil in 12 Hours

A good oil producer has been completed in Osage County, Oklahoma, by Midco Oil Corporation. The new well is the No. 2 Kennedy, which topped the Burbank sand at 2642 ft, and set casing at 2655 ft. Total depth of the well is 2705 ft. On test the well flowed 214 bbl of 39 gravity oil naturally in 12 hours through casing with tools still in the hole.

Most wells in this area come in for 60 to 70 bbl a day and then must be shot to increase production. The Kennedy was still in saturated sand when drilling was stopped. It will be cut back to the allowable of 75 bbl a day.

Continental-Shell Well Completed in Oklahoma

A new producer has been completed in the Beckham County, Oklahoma, section of the Elk City oil field. It is Shell Oil and Continental Oil Companies' No. 3 Smith, which has been plugged back to 10,068 ft. The new well flowed 906 bbl of 52 gravity oil in 24 hours through a 22/64-in. choke with a gas-oil ratio of 2625 ft to 1. Production was from perforations between 9855-75 ft and between 9915-95 ft.

Increased Oil Recovery Studied at Conference

Detergents can be used in the nation's oil fields to produce more oil at a profit, research scientists told producers and engineers from many of the country's fields at the 15th annual technical conference on petroleum production in State College, Pennsylvania, recently.

Four technical sessions dealing with various aspects of petroleum production by secondary recovery methods featured the three-day meeting.

Four field tests with detergents, or wetting agents, in the Bradford field were described by Dr. J. N. Breston, director of the Bradford, Pennsylvania, laboratory of the Pennsylvania Grade Crude Oil Association, and Willard Johnson, research assistant there. The chemicals were added directly to water which was injected into the earth under pressure to drive oil to producing wells. Three of the four tests showed increased oil production traceable to the wetting agent, Breston said. The fourth test is still under way. Others are planned for the Bradford and Wellsville, New York, oil fields.

In two of the three completed tests, value of additional oil produced was twice the cost of the wetting agent, the investigators reported. Their report added that the detergents did not affect noticeably the behavior of water injection wells; only insignificant amounts of wetting agent were found in the oil wells up to six months after injection; no emulsion trouble was encountered, and physical properties of the crude oil produced were reported unchanged.

Robert Macfarlane and Joseph Saxon, Jr., of the Bradford laboratory told the conference that injection of a limited amount of gas just prior to flooding the oil-bearing formation with water is tending to become a standard practice in the Pennsylvania and New York oil fields.

They said recent experiments show that maximum benefit of additional oil recovery can be obtained if the gas injected ahead of the water flood does not dissolve in the oil. The more free gas that can be kept in the oil sand, the greater is the oil recovery and the less is the oil left behind, they reported.

Nitrogen was found superior to such gases as natural gas, propane and carbon dioxide for injection, the Bradfordians disclosed, because it was virtually insoluble in the oil under test conditions, while all the other gases showed considerable solubility.

Dissolving carbon dioxide in crude oil increases the oil volume up to 40 per cent, they said experiments on samples of oil-bearing rock showed, but the inflated oil was not recovered any more efficiently than oil by normal waterflooding. Gaseous and liquid carbon dioxide proved to be better oil recovery agents than carbonated water, they reported. Liquid carbon dioxide extracted the oil by a solvent action and produced no apparent change in the oil's chemical or physical properties, the investigators stated.

M. R. J. Wyllie and Frank Morgan of Gulf Research and Development Company, Pittsburgh, described detailed electric logs, or records, made of the producing sand of a Gulf well in the Velma pool, Oklahoma, and results of analyses made on diamond-drilled samples of the oil formation recovered from the same section as that electrically logged.

It was found, they said, that the electrical resistivity of the sand samples, or cores, filled with oil in the laboratory appeared to be significantly different from the resistivity that the same cores had before being taken from the formation. The difference, they said, indicated that the laboratory method of filling cores with oil may not always reproduce the reservoir saturation.

The value of a more thorough evaluation of the distribution of pore sizes in petroleum reservoir sandstones and effect of this distribution on oil recovery processes was stressed by E. M. Tignor, John F. Noonan and William N. Lockwood of the Franklin, Pennsylvania, station of the U. S. Bureau of Mines. The station conducts research to increase the efficiency of secondary oil recovery from fields in the Appalachian area.

Papers given by members of geophysical and petroleum and natural gas research laboratories covered such subjects as chromatography, radial permeability variations, and many others.

Mexico Oil Field Has Three Flowing Wells

Three good producers are flowing in the Rabon Grande, Mexico's new Veracruz field discovered by Mexican American Independent Oil Company.

A newly completed line to the field has been completed, Petroleos Mexicanos taking the oil to the Minatitlan refinery.

The Mexican oil agency, Pemex, announced that the discovery well and the second and third completions together were flowing at the rate of 1200 bbl per day. Only one well has been abandoned.

Tide Water to Develop Spraberry Lease Holdings

Tide Water Associated Oil Company reports plans for development of its lease holdings in the Spraberry trend in West Texas where the company has 23,000 acres of which 10,000 acres are now proved for production. It recently completed No. 1 Calverley in Southwest Glasscock County, and No. 1 Wilde in Northwest Reagan County, the former had a potential of 660 bbl and the latter 325 bbl. Eight wells are now drilling on the company's leases to offset wells completed by other operators.

THE WILSON

HYDRAULIC

PULLING TOOL

Proven the Safest, Most Economical Tool Available Today

This Pulling Tool incorporates features that combine to insure fast, safe, economical operation. It employs an anchor with slips that are automatically set by the application of a hydrostatic differential in the tool. The slips are also unset merely by equalizing the hydrostatic differential. Consequently when pressure in the drill stem is equalized, or if a leak should develop in the tool or drill stem, the slips will be automatically released from the casing. This feature makes it virtually impossible for this tool to become stuck in the casing because of slip action.

OPERATING CYCLE

Fig. 1 shows tool in position for running into well. In this position the relief valve is closed, circulation may be established, and the fishing tool may be engaged with the fish.

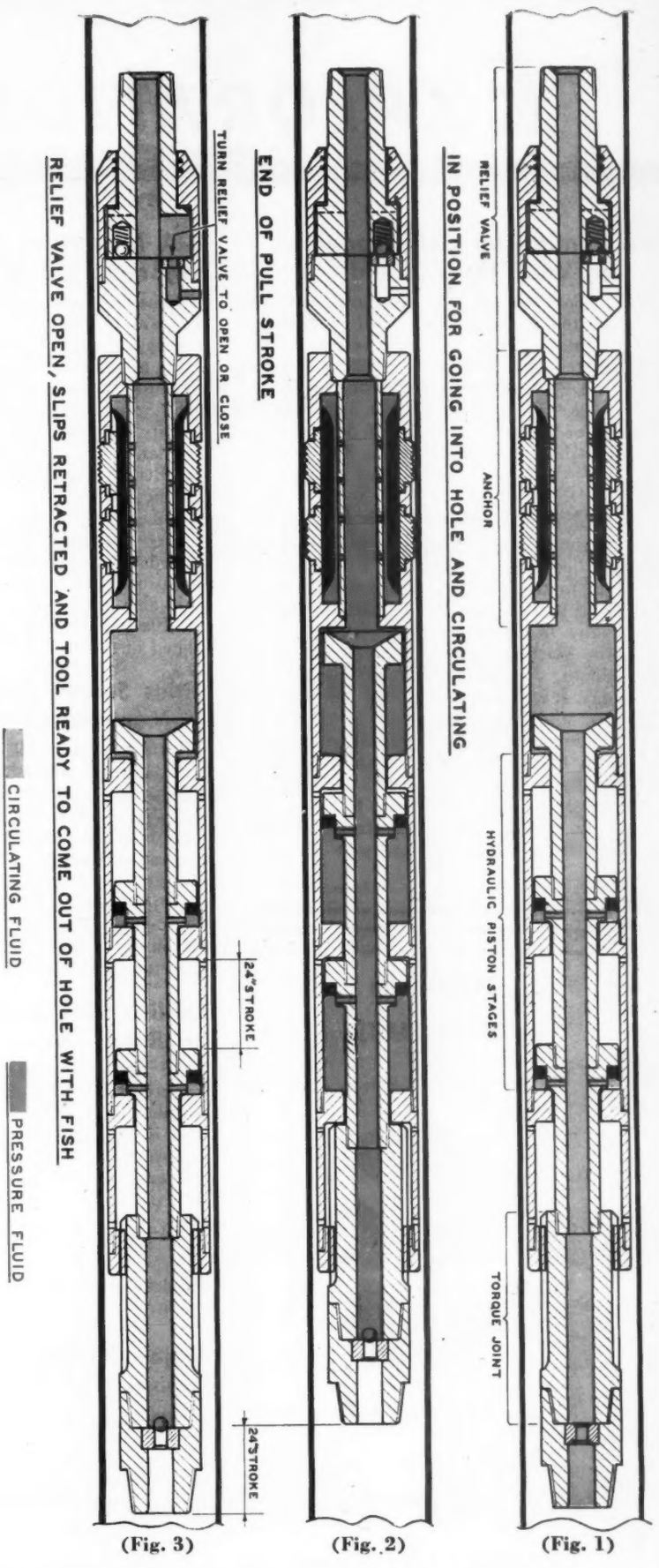
Fig. 2 shows tool at the completion of the two foot pull stroke.

Fig. 3 shows tool with relief valve in open position preparatory to coming out of hole with fish. To open relief valve it is only necessary to slack off on drill stem to the normal weight of same and turn pipe one quarter turn to the right.

▪ ▪ ▪

On your Pulling jobs remember—when you call the Fishing Tool Division of Wilson Supply Company—you get the right men and the right tools to get the job done quickly and successfully.

▪ ▪ ▪


RELIEF VALVE OPEN, SLIPS RETRACTED AND TOOL READY TO COME OUT OF HOLE WITH FISH
TURN RELIEF VALVE TO OPEN OR CLOSE
CIRCULATING FLUID
PRESSURE FLUID
24" STROKE
24" STROKE
END OF PULL STROKE
IN POSITION FOR GOING INTO HOLE AND CIRCULATING
RELIEF VALVE
ANCHOR
HYDRAULIC PISTON STAGES
TORQUE JOINT

(Fig. 3) (Fig. 2) (Fig. 1)

Fishing Tool Division

WILSON SUPPLY COMPANY

BRANCH STORES
TEXAS: Alice, Corpus Christi, Victoria, Bay City, Columbus, Barbers Hill, Liberty, Beaumont, Kilgore, Monahans.
LOUISIANA: Lake Charles, New Iberia, Houma, Harvey, Shreveport.

1412 Maury St.
HOUSTON,
TEXAS

SALES OFFICES
Tulsa, Okla.—Dallas, Texas
New Orleans, La.
Shreveport, La.
FOREIGN SALES
WILSON SUPPLY CO.
P. O. Drawer 19
Houston, Texas

EXPLORATION ACTIVITIES

Continental Gets Producer In West Texas County

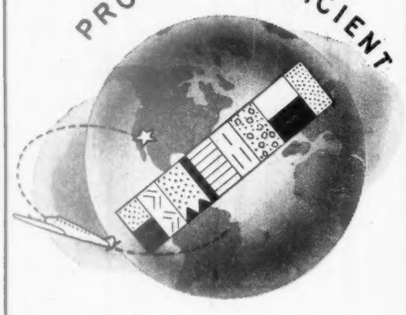
Continental Oil Company has reported a gas-distillate well in Hidalgo County, Texas. The new well was completed at a total depth of 8935 ft, flowing on completion test through 3/16-in. choke at the daily rate of 3,955,000 cu ft of gas and 146 bbl of 56.8 gravity distillate. Gas-oil ratio was 30,000 to 1.

Big Utah Gas Strike Made

Byrd-Frost, Inc., of Dallas, Texas, has drilled a new gas well in Utah, according to its president, D. H. Frost. The new well is the firm's No. 1 Utah Fuel Company in Carbon County, which tested the Morrison at 4692 ft to 4761 ft, total depth, and gaged 9,120,000 cu ft per day. It was begun as a 6000-ft operation, but a drillstem test at 4711-61 ft had made an estimated 7,000,000 cu ft daily, and casing was set at that point. The well will be tied in with a 336-mile pipe line to be laid from Moab to Salt Lake City, which will take gas from fields in central and southeastern parts of state.

PETROLEUM
CONSULTANTS

PROMPT · EFFICIENT



ACCURATE

GEOLOGICAL & ENGINEERING SERVICE

OIL PROPERTIES
CONSULTANTS, Inc.

709-11 SOUTH FAIR OAKS AVENUE

PASADENA 2, CALIFORNIA

B-A May Have New Wyoming Oil Well

British American Oil has made what appears to be an important new discovery in Carbon County, Wyoming.

On a formation test of a 15-ft interval at approximately 6200 ft, the well had a fill-up rate of 20 bbl per hour of 27.7 gravity oil. The productive formation is Sundance. The property is held jointly by British American and the Union Pacific Railroad.

This latest success indicates the discovery of a new field in Wyoming where British American already has substantial production. The new well will probably also contribute to the oil stream of the Platte Pipe Line which will be completed in mid-year 1952.

Cities Service Sets Test In Montana County

Cities Service Oil Company (Delaware) has announced location of a rank wildcat in Yellowstone County, Montana. The 7000-ft test is McFarland No. 1, 15 miles east of the Lake Basin field, nearest commercial production, and 60 miles north of the Elk Basin field.

Objectives are the Dakota, Ellis, and Amsden sands, the Charles, Madison, Devonian, Ordovician, and Cambrian limestone and dolomite.

Phillips Well Indicated In Uintah County, Utah

Oil has been indicated at a Uintah County, Utah, test drilled recently by Phillips Petroleum Company. The test well is 2½ miles west of the original discovery well in the Roosevelt area. Known as the No. 1 Leeton, the Phillips well produced oil during two drillstem tests, both taken between depths of 9724 and 9872 ft. The shallower test recovered oil of 28 degree gravity, and the deeper test showed oil of 33 degree gravity.

Major Oil Discovery Reported in Venezuela

Creole Petroleum Company, subsidiary of Standard of New Jersey has made a major oil discovery six miles from the Quiriquire oil field of eastern Venezuela. H. G. Hamilton, president of Hamilton Well Log Consultants, Inc., of Tulsa, Oklahoma, has reported that the discovery is of major importance to both Creole and Venezuela, "for both have been unable to find a new oil reserve for years."

Hamilton reported that the well opens up a new reservoir, below present major unconformity in deep horizons in eastern Venezuela.

Murphy Corporation Drills Its First Montana Well

The Murphy Corporation of El Dorado, Arkansas, has announced a new commercial producer in the Williston Basin, Dawson County, Montana. The well produced 3200 ft of oil and 500 ft of oil and gas-cut mud on test of the Madison between 5664 and 5682 ft. It is being deepened, however, because other wells in the East Poplar area of Roosevelt County, Montana, show a decline in production from this zone.

Seaboard Gets Large Well In Northwestern Wyoming

Seaboard Oil Company has a large oil producer in the Big Horn Basin of northwestern Wyoming in a wildcat that tested oil from the Tensleep at Whistle Creek in Park County. On an hour's drillstem test between 5788 and 5825 ft, the well recovered 3300 ft of 28 gravity oil. The Tensleep was found at 5795 ft.

Mexico Wells Reported

Sen. Antonio J. Bermudez, general manager, Petroleos Mexicanos has reported 2 new oil discoveries in Mexico. He stated that both of them indicate potentially important new fields. The discoveries were reported in Tamiahua region of Tamaulipas about 220 miles from Mexico City. Pemex stated that both wells tested good-gravity oil at high pressure.

French Company Reports Two Successful Wells

It has been reported that the government-sponsored French company, Soc. des Petroles de L'Arique Equatoriale Francaise, has recovered some oil in a well on the banks of the Ogowe River about 75 miles northeast of Lambarene in French Equatorial Africa. The well is reported to have produced 16 bbl of oil along with considerable water from sands at 3445 ft and 3540 ft.

The same company is also reported to have obtained production from deep formations in the Lacq field in the foothills of the Pyrenees in southwestern France. The Lacq 3, drilling for about a year, is reported to have tested good gravity crude at more than 100 bbl an hour from 11,440-11,506 ft.

Utah Gas Well Completed

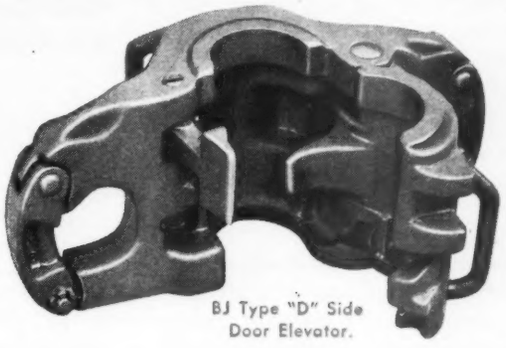
A new gas well has been drilled in Utah by Byrd-Frost, Inc., Dallas, Texas. It is the company's No. 1-A H. L. Rath, in Emory County, which has casing set at 2805 ft to drill ahead to expected lower production. From a section at 2,690,700 the well showed an estimated 3,500,000 cu ft per day.

BJ *ENGINEERED*

OIL TOOL REBUILDING

makes old elevators good as new!

BJ Type "MAA" Elevator with Latch Lock.



BJ Type "D" Side Door Elevator.

Modern, high speed drilling operations subject an elevator to terrific shock and wear. Here's how BJ's factory rebuilding service repairs worn elevators.

1. Magnaflux inspection finds cracks the eye does not detect.

2. Worn surfaces are rebuilt with carefully selected welding rods.

3. Controlled reheat treatment restores steel to its original physical properties.

4. Precision machining is assured by means of the correct fixtures as used in the original production of BJ elevators. This procedure provides perfect fits and new efficiency.

5. All tool joint lifting surfaces are flame-hardened for maximum life.

6. And the final magnaflux inspection assures you of the care and supervision that goes into the repair of BJ elevators.

The men and machines that made 'em know 'em best!

ASK YOUR BJ REPRESENTATIVE OR JOBBER...

BJ
FACTORY SERVICE
Engineered
OIL TOOL REBUILDING
for safety and long life

Byron Jackson Co.

MID-CONTINENT AND ROCKY MOUNTAIN SERVICE
6247 Navigation Blvd., Houston, Texas • Woodcrest 8321

PACIFIC COAST SERVICE
2301 E. Vernon Ave., Los Angeles 58, Calif. • Jefferson 6171

3649—Martin R. Klitten Co.—951

North Dakota Chalks Up Fourth Producing Oil Well

North Dakota has its fourth producing oil well with the discovery of the Math Iverson No. 1, drilled by Tioga Petroleum Corporation. The well flowed oil to the surface during a 3-hour drill-stem test, at an estimated rate of 40 bbl of oil an hour, from a test taken at 8360 to 8500 ft. The first well was 1¼ miles from the new well and was drilled by Amerada Petroleum Corporation last April.

British Columbia Well Country's First Oil

When Pacific Petroleums, Ltd., brought in its Allied-Fort John No. 1 well, the first oil discovery in British Columbia was made. The well, in the Peace River area of northeast British Columbia, was completed in limestone of the Permo-Pennsylvanian age.

Gas was recovered in 4 minutes from the interval 5633-5655 ft, with the valve open for 90 minutes. There was a recovery of 125 ft of gassified mud, 900 ft of green, light gravity oil, and 480 ft of salt water. The well is situated a few miles north of Fort St. John, 50 miles up the Alaska highway from Dawson Creek, B. C.

Oklahoma Well Drilled

Mid-Continent Petroleum Corporation has a new well in Cleveland County, Oklahoma, which it reported flowed 238 bbl of 40 gravity oil in 24 hours through a ¼-in. choke. Total depth of the well, the No. 1 Mullins, is 9553 ft in the Joins sand. Prior to the test, the well flowed 30 bbl of oil an hour through a ½-in. choke in 24 hours.

Union Oil Is Given California Concession

The Union Oil Company has been granted permission to conduct offshore seismic exploration activities from Carpenteria to Point San Mateo near Capistrano Beach, California, by the California State Fish and Game Commission. The permit will run for 90 days, beginning December 4, the commission announced.

Sinclair Completes New Colorado Wildcat

Sinclair Oil and Gas Company has reported completion of a wildcat well in the southwestern corner of Logan County, Colorado. The well, known as the No. 1 Phillips, flowed at the rate of 324 bbl of 36-gravity oil in the first 24 hours. It is drilled to a total depth of 5116 ft.

New Gas Area Opened By Mississippi Well

A new gas discovery in Mississippi came in blowing gas 180 ft in the air recently. It is the Malcolm N. McCaskill and Northeast Mississippi Oil Company, Inc., No. 1 J. T. Sanders in Monroe County, northeastern Mississippi. The discovery well blew in while crews were cleaning out an old test to 2900 ft. The rank wildcat is 22 miles southwest of the depleted Amory gas field.

The well was originally drilled to 6060 ft and abandoned by Carter Oil Company. Situated some 100 miles northeast of the nearest oil field, the Pickens area of Yazoo and Madison counties, the well is believed to be producing from the Pennsylvanian gravels found at about 2900 ft.

West Virginia Gas Well Flows 10 Bbl Per Day

Big Injun Development Company has completed its No. 1 Augustus and Bruce Weekley in the Maxon sand, Ritchie County, West Virginia. The 10-bbl a day producer has been completed at a total depth of 1534 ft.

Dutch Oil Discovery

Nederlandse Aardaolie, Mij. has announced the finding of gas in commercial quantities near Tubbergen, in Overijssel Province, the Netherlands. The company reported that the successful test well was drilled on an anticline stretching eastward from Ommen in to Germany. Productive area was reported to cover nearly 18,000 hectares.

First Test Well Drilled Nigeria, West Africa

A joint affiliate of Royal Dutch-Shell and Anglo-Iranian Oil Company has spudded-in the first deep test well ever drilled in Nigeria in West Africa. The well is being drilled near Owerri in the eastern part of the country, by Shell-D'Arcy Petroleum Development Company of Nigeria.

The two companies have been carrying out exploration work since 1946, and at present time about ¾ of their 60,000-mile concession has been covered by seismograph and gravity tests. Seepages have long been in Nigeria, and the companies believe that it will now be possible to obtain a clearer picture of commercial production.

Australian Company Set Up

West Australian Oil Prospecting Company has been formed by the Caltex group and Ampol Petroleum Ltd., Sydney, Australia. The company is reported to have been created to conduct exploratory work in West Australia near North West Cape. Reports stated further that American technicians already have arrived, and equipment is being assembled.

Rhine Valley Test Made

A new wildcat is underway in the Rhine Valley, the Gewerkschaft Elwerath's Wolfskehlen 2, 1300 ft northwest of Wolfskehlen No. 1, which blew out August 3 and caught fire. Although previous experience had shown that no crude or gas could be expected before a depth of 4875 ft, Wolfskehlen No. 1 blew out at 2950 ft. No information has been released on this newest test.

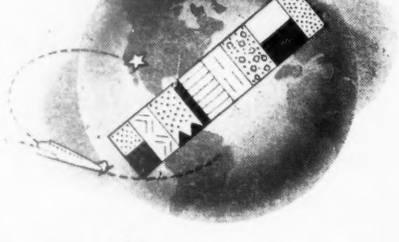
Arkansas Wildcat Completed

Skelly Oil Company recently completed a new well in the Fouke area of Miller County, Arkansas. It is the company's No. 1 Agnes Philyaw, which was completed from the Tuscaloosa at 3554-60 ft to pump 23 bbl of 30 gravity oil daily and 8 bbl of salt water.

The new well is situated about 2 miles northwest of the Northeast Fouke field, which was opened by Skelly.

Complete LABORATORY SERVICES

PROMPT · EFFICIENT



ACCURATE

- CORE
- GEOCHEMICAL
  Correlation by D.T.A. and Radioactivity Determination
  Complete Mineral Analysis
- OIL & GAS
  Fractional Analysis
  P.V.T. Studies
- PALEONTOLOGICAL
  Microfaunal Determination and Correlation
- MUD & CEMENT TESTING
  Under Reservoir Conditions

PETROLEUM ENGINEERING ASSOCIATES, INC.

Affiliate
PETROLEUM INDUSTRY CONSULTANTS C. A.
Edificio Carabobo—Caracas, Venezuela

709-11 SOUTH FAIR OAKS AVENUE
PASADENA 2. CALIFORNIA
TELEPHONES
SYCAMORE 3-1156
RYAN 1-8141

BE KIND TO RESERVOIRS WEEK

You can never be too understanding of an oil and gas producing formation if you expect it to remain your best friend throughout its productive life.

Each particular reservoir is born with its own unique maximum recovery characteristics, ie., its ability to relinquish maximum high-gravity yield at minimum pressure decline. Therefore, to maintain an optimum recovery program you must learn, *early in the life of the field*, how much of the oil which you have discovered is really *recoverable* oil; how many of those recoverable reservoir barrels can be actually counted today as tomorrow's *stock tank barrels;* and by what mechanical procedures you can establish an ultimately successful production program.

No standard rules exist which fit perfectly any two producing operations. Each horizon must be studied individually, *before pressure decline can alter basic productive characteristics.*

Even at that, there's nothing complicated about it. Immediately after the completion of a key well, simply ask Core Lab to take a sample of the reservoir fluid and develope a comprehensive Reservoir Fluid Analysis Report. This vital information, combined with other formation data, then becomes your own specific "maximum reservoir revenue formula" —*good for the life of the field!*

The cost? A drop in the bucket, as compared to the increase in recoverable oil.

If it's worth producing,
it's worth producing RIGHT!

Ask your Core Lab man today
about Reservoir Fluid Analysis!

CORE LABORATORIES, INC. ● **IN ALL ACTIVE AREAS**

Dallas, Houston, Corpus Christi, Midland, Abilene, San Antonio, Tyler, Wichita Falls, Lubbock, and Post, Texas; Oklahoma City, Oklahoma; Great Bend, Kansas; Shreveport, Lafayette and New Orleans, Louisiana; Natchez, Mississippi; Bakersfield, California; Denver, Colorado; Worland, Wyoming; El Dorado, Arkansas; Farmington, New Mexico; Calgary and Edmonton, Canada; Venezuela, S. A.

CORE LAB

PETROLEUM RESERVOIR ENGINEERING

Running tour with men in the industry

▸ **F. M. McDaniel,** Great Bend, Kansas, formerly assistant production superintendent of Sunray Oil Corporation's Kansas district, is being transferred to the Midland, Texas area, where he will be assistant district superintendent in charge of Sunray's North and West Texas production activities.

Perry A. Gill, Midland, is Sunray superintendent for the North and West Texas district.

Sunray's increasing activity in the North and West Texas oil areas, especially in the Spraberry trend, has necessitated the addition of McDaniel to the Texas supervisory staff. He has been associated with Sunray since 1944 in engineering and supervisory capacities.

Sunray has also announced creation of a new operating area for its Spraberry wells formerly attached to the company's Odessa operating area. The new area will include the Sherrod and Boone leases in Upton and Reagan counties. **John Binkley,** formerly a senior engineer in Sunray's Midland, Texas, production department office, is now field superintendent over the Spraberry area.

▸ **John McBride** has joined the geological staff of Bell Brothers, Robertson, Illinois. He is a recent graduate of Oklahoma University.

▸ **Rhea J. Smith,** Jackson, Mississippi, has been named head of the land department for The Carter Oil Company's southern division, with headquarters at Shreveport, Louisiana. His appointment follows more than 15 years of service with Carter in Louisiana, Arkansas, and Mississippi. In his new assignment, Smith will direct Carter's land activities in Alabama, Arkansas, Louisiana, and Mississippi.

Smith attended school at Brookhaven, Mississippi. He began his Carter service as a lease man at Shreveport in 1936, was made district land man in 1941 and since 1947 has been at Jackson as manager of Carter's district office there.

▸ **William W. Price,** Norman, Oklahoma, senior in the University of Oklahoma school of petroleum engineering, has been named to receive a $500 California company scholarship for the 1951-52 year.

Price was chosen by the school's scholarship committee on the basis of "accomplishments through his junior year." He is the son of Mrs. King G. Price, Norman. In a total of 112 hours, he has compiled a grade average of 2.958.

His field experience in petroleum engineering includes two summers as a drilling "roughneck" in 1949 and 1950.

▸ **B. C. Broocks,** 29-year Sun veteran who has been superintendent of the Corpus Christi district, has been appointed regional superintendent of production in Sun Oil Company's Southwest division.

B. C. Broocks

He succeeds **Marvin L. Brown,** who recently moved to Calgary, Alberta, Canada, as superintendent of production for the company's Canadian division. In the new position, Broocks will live in Dallas, and will supervise production activities in the East Texas, McAllen and Corpus Christi districts.

Robert E. Bates, a Sun man for almost 33 years and drilling superintendent in Southwest Texas for 12, will succeed Broocks as district production superintendent at Corpus Christi. Broocks joined Sun in 1922, as warehouseman at Vivian, Louisiana. He soon was scout and land agent there; then became district superintendent at Lockhart, Texas, and later of the Rio Grande district.

Numerous changes in the operating department have also been announced. Highlighting these was the naming of assistant district superintendents for four districts, as follows: Corpus Christi, **George F. Carson;** McAllen, **C. W. Underwood;** Midland, **Cecil A. Colville;** and East Texas, **R. P. Smith.** These are newly created positions.

Carson formerly was field superintendent of the Delhi Area, Louisiana. Underwood already was at McAllen, serving as district petroleum engineer. Colville moves from Premont, Texas, where he was field superintendent. Smith moves to Tyler from Dallas, where he was assistant field superintendent.

Other changes were listed as follows:

J. T. Hightower, field superintendent at Colorado City in West Texas, to the Dallas office as field superintendent.

J. B. Higginbotham, from assistant field superintendent, Dallas, to assistant field superintendent in charge of Hebbronville area, Southwest Texas.

H. P. Aston, from assistant field superintendent, Midland, West Texas, to field superintendent in charge of Delhi area.

H. D. Smith, from assistant field superintendent in charge of Robert Lee area, West Texas, to assistant field superintendent in charge of the new Copano Bay area just above Corpus Christi.

C. C. Bengston, from district engineer at Midland to assistant field superintendent in charge of the Robert Lee area.

L. J. Thronson, from assistant field superintendent in charge of Freer area, Southwest Texas, to field superintendent in charge of Premont area.

J. V. Prestridge, from foreman in Victoria area, Southwest Texas, to assistant field superintendent in charge of Freer area.

Joe Palmer, from oil tester at Premont to foreman at Freer.

P. S. Dudley, from assistant field superintendent in charge of the Hebbronville area to assistant field superintendent in charge of the Gainesville area in North Texas.

E. L. Kownslar, from assistant field superintendent of Snyder area in West Texas to field superintendent at Colorado City.

Max Dyer, from assistant field superintendent of Gainesville area to assistant field superintendent at Snyder.

R. J. Bethancourt, from field petroleum engineer at Freer to Dallas for an engineering assignment.

W. J. Turner, from field petroleum engineer at Premont to district engineer at McAllen; **B. W. Payne,** from field petroleum engineer at Corpus Christi to Premont in similar capacity; **George P. Moncrief,** from petroleum engineer at Colorado City to district engineer at Midland.

▸ **R. N. Harding,** geophysical supervisor for The Texas Company at Denver, Colorado, was promoted from assistant to division manager, geophysical division, production department recently. He succeeds **B. H. Treybig, Jr.,** recently resigned to move to Houston, Texas. **R. L. Wales,** geophysical supervisor at Calgary, Alberta, Canada, has been promoted to assistant to the division manager. He will remain in Calgary.

DEATHS

▸ **Ed Peters,** Fort Worth oil well drilling contractor, died recently. He was a partner in the Johnn Drilling Company in Fort Worth and previously had been associated with the Hunt Oil Company and the Frank and Fred Jones Drilling Company, Dallas, Texas. He had lived in Dallas about 20 years before moving to Fort Worth.

What's NEW

In Perforating, Testing, and Fishing Tool Services

McCULLOUGH®
NEW SERVICES • NEW TOOLS
NEW WAYS OF DOING THINGS

Latest News About New Tools, Techniques and Services

SAVE TIME, MONEY and PIPE

With McCullough Jet Back-Off Tool or String Shot Service and the One and Only Magna-Tector!

Pipe is scarce and rig time is costly. What could be more economical than backing-off the pipe, recovering all free pipe above the stuck point in one piece, and getting it done in a fraction of the time?

Yet there are limitations in the use of only ONE back-off tool in attempting to free stuck drill pipe, drill collars, subs, casing, tubing and wash pipe. NO ONE TOOL can accomplish EVERY back-off job. But there are TWO back-off tools and between the two, EVERY TYPE of back-off job CAN be accomplished!

That is why McCullough crews arrive at your well with both the McCullough Jet Back-Off Tool and String Shot. These tools plus the McCullough Magna-Tector, that quickly and accurately locates the stuck point, represent an extremely versatile combination service designed to save you time, money and pipe.

These are NOT mechanical tools or fishing tools. They are progressive tools, electronically controlled for accuracy and speed. They are responsible for the sharp decline in fishing in recent years, permitting wells to be drilled faster—saving oil operators thousands of dollars!

HOW YOU SAVE TIME, MONEY AND PIPE

1. TIME SAVER
   a. Accuracy of the McCullough Magna-Tector in locating the stuck point consistently, eliminates unnecessary back-off shots.
   b. New, high-temperature, high-pressure resistant detonators in the back-off tools eliminate misruns.
   c. These electric wire line tools are run into and out of the well in a fraction of the time required with mechanical cutters.
   d. In addition they are electronically controlled permitting greater speed and accuracy than ordinary electric wire line tools.
   e. Electronics also provides MORE information about conditions in the well—locating collars, tight places, fluid level, etc., both audibly and visibly.
2. MONEY SAVER
   a. McCullough Back-Off Service accomplishes ANY TYPE of back-off job, leaving the fish in good condition for subsequent operations.
   b. The use and need of a rotary table is eliminated.
   c. McCullough Magna-Tector, many times, indicates that working and spotting oil will free the pipe, eliminating the need of backing-off and fishing.
   d. Guesswork is eliminated.
3. PIPE SAVER
   a. Eliminates cutting and damage to the pipe.
   b. Permits recovery of all free pipe in one piece and the freeing and recovery of all stuck pipe in undamaged sections.

WHAT TO DO

When your pipe becomes stuck—CALL McCullough IMMEDIATELY! The McCullough Magna-Tector will quickly locate the lowest free point, the stuck point and do it accurately. Then the McCullough Back-Off Service will free all loose pipe in one piece—simplifying the fishing job.

Since time is important McCullough Back-Off Service is fast. All free pipe will be removed BEFORE it can stick further up the hole.

No two stuck pipe conditions are exactly alike. This is another reason why you NEED McCullough VERSATILE Back-Off Service. The complete equipment, the skill of experienced McCullough crews, and the special techniques they have devised WILL SAVE YOU TIME, MONEY AND PIPE!

Call McCULLOUGH!

WRITE FOR THIS CATALOG

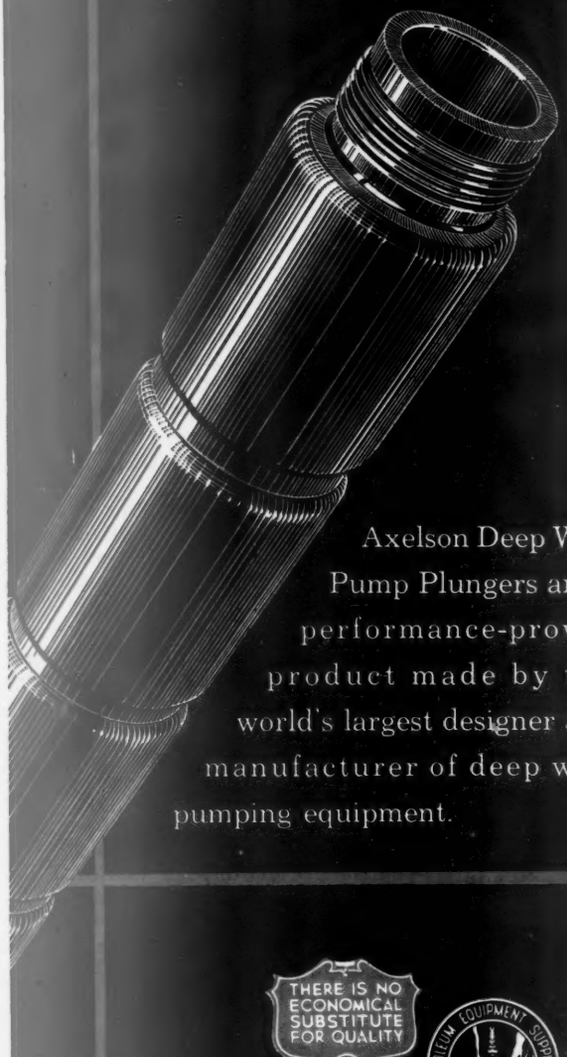
Pages 3228 to 3231 in the McCullough section of the Composite Catalog describes these tools individually and in detail—with illustrations, specifications and operating data. Write for your free copy today.

PERFORATING, TESTING AND FISHING SERVICE ANYWHERE — ANYTIME!

McCULLOUGH TOOL COMPANY
5820 South Alameda Street, Los Angeles 58, California
405 McCarty Street (P.O. Box 2575) • Houston, Texas
CANADA: Edmonton, Alberta • EXPORT OFFICE: Los Angeles, California
VENEZUELA: United Oilwell Service Co., S.A.; Caracas, Anaco, Maracaibo

SERVICE LOCATIONS: TEXAS: Houston, Snyder, Alice, Cisco, Corpus Christi, McAllen, Odessa, Tyler, San Angelo, Victoria, Wichita Falls. **OKLAHOMA:** Oklahoma City, Guymon, Healdton. **MISSISSIPPI:** Laurel. **NEW MEXICO:** Hobbs. **KANSAS:** Great Bend. **WYOMING:** Casper. **CALIFORNIA:** Los Angeles, Avenal, Bakersfield, Ventura. **LOUISIANA:** Houma, Lake Charles, New Iberia, Shreveport. **COLORADO:** Sterling.

AXELSON
First Choice



Axelson Deep Well Pump Plungers are a performance-proved product made by the world's largest designer and manufacturer of deep well pumping equipment.

THERE IS NO ECONOMICAL SUBSTITUTE FOR QUALITY

PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION MEMBER

ASK AN AXELSON EXPERT

AXELSON MANUFACTURING CO. • PLANTS—Los Angeles 58; St. Louis 16 • OFFICES—New York City 7; Tulsa 1; Buenos Aires, Argentina; Caracas, Venezuela • DISTRIBUTORS—Jones & Laughlin Supply Co.; Great Northern Tool & Supply Co.; Industrial Agencies, Ltd., San Fernando, Trinidad, B.W.I.; Industrias Waldrip & Campbell, Barcelona & Maracaibo, Venezuela; Dominion Oil Field Supply Co., Ltd., Calgary, Canada; South American Supply Co., Avenida Tacna 592, Lima, Peru.

Joseph J. Lawnick, exploitation engineer for Shell Oil Company, has been transferred to Odessa, Texas. He was formerly stationed in Lake Charles, Louisiana.

Denver Taylor recently joined Continental Oil Company at Evansville, Indiana, as a geologist. He is a recent graduate from the University of Michigan.

H. J. Southwick recently joined Ned Biffle Drilling Company at Shawnee, Oklahoma. He will be the new superintendent in charge of drilling and producing operations. He was formerly production manager for Williams-Copeland, Inc., at Tulsa, Oklahoma, and before that he worked in the Ringwood, Oklahoma, field with Mazda Oil Corporation as production superintendent.

W. A. Grant will head the newly organized Grant Oil Company recently formed in Wichita, Kansas. Grant was formerly a partner in the Harber Drilling Company. **Paul Pfiefer** will become production superintendent for Grant Oil.

J. Whitney Lewis, former consulting geologist, New York City, has been named mining law consultant to the Indonesian government. His headquarters will be at Djakarta, Indonesia.

C. A. Wick will have new headquarters in McLeansboro, Illinois, for Ohio Oil Company. A production superintendent in Wooster, Ohio, Wick has been with Ohio Oil for 22 years.

Dr. Karl Dyk, chief geophysicist for Stanolind Oil and Gas Company, was general chairman of the 5th annual Midwestern meeting of the Society of Exploration Geophysicists held in Dallas, Texas, last month.

Dr. Dyk joined the Western Geophysical Corporation in 1935. In 1940, he was employed by Stanolind, advancing to division seismograph supervisor in 1945 and chief geophysicist in 1947. He received his B.S. degree from the University of California at Berkeley in 1930, returning there for his Ph.D. in seismology in 1934. In addition to the Society of Exploration Geophysicists, he is also a member of the American Geophysical Union, Seismological Society of America, American Association of Petroleum Geologists, and Fellow of Geological Society of America.

here it is... the New BJ PYRAMID TOOTH tong die

SAFER TO USE!
WILL NOT CHIP

BJ's exclusive Selective Hardening process provides shock-absorbing core and ends plus super-hard teeth.

For all rotary and casing tongs

Byron Jackson Co.
Since 1872
MAIN OFFICE & PLANT: LOS ANGELES 54, CALIF.
Mid-Continent Office & Plant: Houston 1, Texas
Export Office: New York 17, New York
JOBBERS IN ALL PRINCIPAL OIL FIELDS

ANOTHER BJ ENGINEERED PRODUCT

M. E. McCullough

M. E. McCullough, a partner in the firm of Fain and McGaha, Wichita Falls, has been elected vice president of the Texas Mid-Continent Oil and Gas Association's North Texas district. He succeeds **R. Clay Underwood,** Wichita Falls independent operator. McCullough is president of the North Texas Oil and Gas Association and is a director of the West-Central Texas Oil and Gas Association.

R. D. Roberts has been named western division geophysicist for Sohio Petroleum Company, with offices in Oklahoma City. He was formerly geophysical field superintendent for Sohio in Houston, Texas. **Jessee L. George, Jr.,** district geologist at Houston has been moved to Lafayette, Louisiana, in a similar capacity.

F. M. McDaniel has been transferred to the Midland, Texas, area by Sunray Oil Corporation to be assistant district superintendent in charge of the firm's north and West Texas production activities. Before his transfer, McDaniel was assistant production superintendent for Sunray's Kansas district.

G. S. Dietz, formerly senior petroleum engineer for Stanolind Oil and Gas Company has been named a valuation engineer for the First National Bank of Houston, Texas. He will work in the oil and gas department of the bank, it was reported.

W. Ellis Hall, subdistrict geologist for Atlantic Refining Company at Casper, Wyoming, has been promoted to division research geologist and transferred to Midland, Texas.

T. A. Kindsvater, field superintendent for British American Oil Producing Company in East Texas, was transferred recently to the company's newly created office and promoted to district superintendent. **G. H. Walkup** will replace Kindsvater in the East Texas field. Walkup was formerly field foreman for British American in the Southern district at Houston.

Penn Gouldy and **Wade Moore** have been named district geologists in the newly set up Casper, Wyoming, district offices of Union Oil Company of California. **Carrill R. Crawford** and **James C. Doyle** will be additional geologists in the district.

T. A. Ramey has been appointed Texas and Oklahoma representative of the Thompson Drilling Company, Inc., according to George A. Thompson, president. Since graduating from the University of Southern California with a degree in petroleum engineering, Ramey has spent the last 14 years in sales work for rotary machinery manufacturers. Thompson Drilling Company headquarters are in Cushing, Oklahoma.

Albert V. Lockett, civil engineer, Humble Oil and Refining Company's East Texas division was promoted to district civil engineer of the Means district, West Texas division.

Leon B. Parker, civil engineer in the Gulf Coast division, became district civil engineer of the Tomoconnor construction district, gas construction division, in Southwest Texas. Parker also joined Humble in 1946.

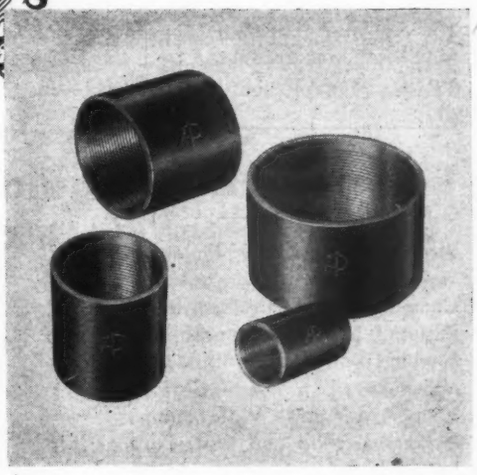
D. J. Lewis, Humble's district civil engineer for Anahuac, was transferred to the Gulf Coast division office as supervising civil engineer. **J. H. Pittman,** district civil engineer for the Houston construction district, went to the Anahuac district as civil engineer. Both men have been with the company since 1937.

In another promotion, **S. J. Lewis,** senior civil engineer in the Gulf Coast division office, became assistant division civil engineer for East Texas. He joined the company 14 years ago.

There's a good way to get acquainted with

HARRISBURG COUPLINGS

too!



If you haven't yet "made the acquaintance" of *Harrisburg Seamless Steel Pipe Couplings* in your business . . . isn't it about time you got to know the superior features of this fine product?

It's easy. All you have to do is call in the Harrisburg distributor nearest you, and let him show you samples . . . go over these couplings point by point . . . and quote you prices and delivery. Then *you* decide!

Among other things, *Harrisburg Couplings* are made to A.P.I. and A.I.S.I. specifications . . . in A.P.I. casing, A.P.I. line, drive, water well, and other types. Ask your Harrisburg distributor. Or write the factory for full details.

Consult our Oil Country Distributors or write Harrisburg.

SEE OUR CATALOG IN THE COMPOSITE CATALOG

HOUSTON 1
Henry H. Paris Distributor, Inc.
LOS ANGELES 58
Howard Supply Company
TULSA 1
W. C. Norris Manufacturer, Inc.

HARRISBURG STEEL CORPORATION
Harrisburg 7, Pennsylvania

Custom-Built Quality Products in Quantity
98 YEARS IN PENNSYLVANIA'S CAPITAL

S. T. McCardell has been named assistant division manager, Louisiana Division, producing department, The Texas Company. He has been general superintendent—drilling and production since November 1948.

J. L. Shea, Jr., district superintendent, Houma, Louisiana, district, has been advanced to McCardell's present job.

J. H. Gibbens, assistant district superintendent, Harvey field, will move up to district superintendent at Houma.

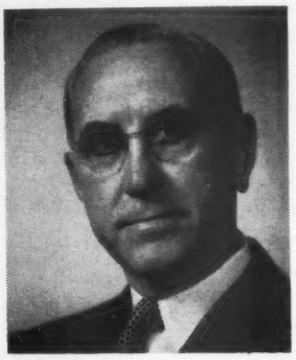
Replacing Gibbens at Harvey field will be **J. J. O'Brien,** assistant to general superintendent — drilling and production, division office, New Orleans.

McCardell was graduated from Louisiana State University with the B.S. degree in petroleum engineering in 1933. He joined The Texas Company as a rotary rig helper at Port Neches, Texas, that year.

Shea was graduated from LSU in 1936 with the BS degree in petroleum engineering. In July that year he began as a junior petroleum engineer at Shreveport with Texaco. Transferred to Houma in 1938, he worker, successively, as petroleum engineer, district petroleum engineer, drilling and production foreman, and district superintendent at Houma.

J. H. Gibbens studied at LSU. In 1934, he was employed by The Texas Company as a roustabout at Houma. After serving as driller and drilling and production foreman, he was made assistant district superintendent at Houma in 1948 and named to the same position at Harvey later that year.

O'Brien was graduated from the University of Colorado with B.S. degree in mechanical engineering in 1935. His first permanent job with The Texas Company was as field clerk warehouseman at Shelby, Montana. He served in various jobs in the producing department in Montana and California before he was transferred to New Iberia, Louisiana, as a petroleum engineer in the Louisiana-Arkansas division in 1941.



J. M. Vetter

John M. Vetter has been named first vice president of Pan American Production Company. Heretofore vice president of the company, Vetter is one of the original employees of Pan American Production Company, having joined that company as chief geologist on August 8, 1935. He was employed in various managerial positions until 1950, when he was elected vice president. Vetter is widely known in the oil industry and in national geological circles, having served as vice president of the American Association of Petroleum Geologists in 1940 and is a past president of the Houston Geological Society and the Houston Engineers Council, and presently a director of the local Tax Research Association.

He obtained his B.S. degree in geology from Nebraska University in 1922, after which he joined the Mexican Eagle Oil Company at Puerto, Mexico, as field geologist. Two years later he resigned and returned to Houston to join Rio Bravo Oil Company as geologist and was later advanced to the position of superintendent of land and geological work for that company.

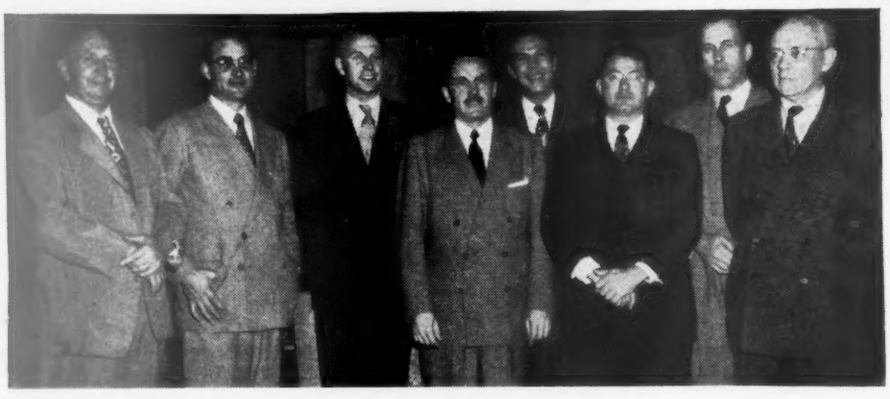
Charles O'Boyle has been named assistant chief geologist for Union Oil Company of California. He formerly was independent geological consultant at Denver, Colorado. Charles Edwin Riddell was recently appointed division geophysicist for Union with headquarters at Denver. Before joining Union, Riddell was with United Geophysical Corporation in Brazil.

W. G. Inabnet, district superintendent for Shell Oil Company at Hobbs, New Mexico, was recently transferred to the Tulsa, Oklahoma, area. **W. B. Banks, Jr.,** mechanical engineer at New Orleans, Louisiana, has been transferred to Hobbs; **P. W. Miller, Jr.,** exploitation engineer at Odessa, was transferred to Hobbs; **E. W. Nestor,** exploitation engineer at Hobbs, was transferred to Midland, Texas, and **W. T. Weller,** junior mechanical engineer at Midland, has been promoted to mechanical engineer.

Hugh Armstrong and **L. B. Horn** have organized the Armstrong and Horn Drilling Company. Headquarters for the newly formed company will be in San Antonio, Texas. Armstrong was with Armstrong and Sutton Drilling.

Guests at the Regular Meeting of New York Nomad Chapter

Below—Myron Kinley, Kinley Fire Fighters, Houston; Alvin J. Armell, Companhia dos Petroleos de Portugal; J. Leisk, Anglo Saxon Oil, London; Walter H. Porth, A. O. Smith, Milwaukee; L. F. Marsh, Standard Vacuum, Sumatra; W. R. Patton, Parkersburg Rig and Reel, Caracas; Fernando Reich, Corporacion de Fomento de la Producion, Chile, and G. B. Hanson, Howe Baker, Houston.



Above—Charles Richardson, Creole, and R. Early, International General Electric, S.A., Caracas, Venezuela; Les Tedsen, Arabian American; P. Nibley and W. Chandler, Trans-Arabian Pipeline, Saudi Arabia; M. E. Campbell, Security Engineering, Whittier, California, and Roy Haug, Arabian American, Saudi Arabia

LPG—

Oil's Fourth Dimension

ARCH L. FOSTER*

Liquefied petroleum gases are recovered in ever increasing quantities from towers such as these installed recently in the Taylor-Mayfair gasoline plant at McAllen, Texas.

THE "Ugly Duckling" of the petroleum and natural gas industries has assumed, over a relatively short period, the status of the Crown Prince of the dynasty, with a commanding, probably a ruling position in the fluid fuel fields of the nation and the world. Rugh of Phillips' Philgas Division points out that in 1949 the industry marketed 2,725,000,000 gal of propane and butane (LP-Gas). Of this quantity, 650,000,000 gal were sold as fuel directly to homes and farms; 310,000,000 gal went as industrial fuel; 240,000,000 gal as gas manufacturing medium, and 525,000,000 gal as chemical raw materials.

In other terms Alden and collaborators estimate that LP-Gas grew from a total liquefaction of 165,000 bbl per day in 1940 to 668,000 bbl per day in 1950. Of this total liquefaction Alden estimates that 168,000 bbl per day was utilized to butanize motor fuel; 262,000 bbl per day for refinery conversion stock (butadiene, alkylate, etc.); and 238,000 bbl per day to sales. The annual growth in recovery of LPG has been about 15 per cent, while LP-Gas sales have grown about 26 per cent annually with a lesser rate in more recent years. LP-Gas for power purposes is the exception to this slower rate of growth.

At even these large figures, slightly more than half the total available propane and butane in refinery gases were recovered in 1950; only one-fourth of the propane and butane available in gas processed in natural gasoline plants was recovered that year. All of this warrants the estimate that at least 739,000 bbl per day of C_3's and C_4's could have been recovered in 1950 in addition to the 668,000 bbl per day actually recovered, or more than double that year's marketable recovery.

More significant than all these data is the fact that, in U. S. petroleum reserves in 1950, nine-tenths of a gallon of LPG was potentially available for each gallon of motor gasoline available. Mental digestion of this figure requires some thought and some exercise of the imagination. Reference to the accompanying table of reserves, taken from the May, 1951 paper before the API Refining Division, shows that, based on a 42.5 per cent total yield of motor gasoline from the estimated crude reserves, and from natural gas (gasoline), 16 billion barrels of motor fuel is in reserve. LP-Gas from refineries and from natural gas that is processable, 14.3 billion barrels are in reserve, or 0.89 gal of LP-Gas for each gallon of motor fuel.

The gist of this is that within a few years, 10 or some such period, it is very possible that for each gallon of motor fuel sold nearly a gallon of LP-Gas may be marketed. More discussion of this item is given later herein.

The immediate result of thinking on this possibility, along with the present trend of market demand is shown in the apparent fact that, so far as we know every natural gasoline plant under construction, or built recently, and every gas concentration unit in refineries, has included in the design facilities for the recovery of LP-Gas, well beyond the capacity now required to meet ever-growing market demands. Published figures show that the LP-Gas content of natural gas now being processed ranges from less than a gallon per 1000 cu ft to practically 10 gal, the latter figure a very important indication. At the same time the LP-Gas from crude runs to stills in our refineries in 1949 averaged 7.56 volume per cent of that crude. All of these items bring out the assertion that LP-Gas stands to increase our crude reserves, in terms of motor fuel only, as much as 50 per cent by its increased use as motor fuel.

Economical Storage Key to Problem

The major problem in the economical production and marketing of increased quantities of LP-Gas is that of storage. The relatively low-capacity storage required at bulk plants and other distributing points can be and is supplied by steel fabricated capacity and offers no greater problem than that of obtaining the needed steel. Bottled gas consumption is in a great measure seasonal, and if economical utilization of recovery capacity is to be managed by the industry, it is necessary to recover and store LPG, during off-consumption periods, as in the case of home heating during summer, to enable the producer to meet the demands made on him during peak-consumption periods. In short, the refiner and gasoline manufacturer must either build excess day-by-day capacity, an uneconomic step, to meet peak demands, or he must build such capacity as, when operated continuously will produce in a year all the LPG his market demands during that year. This means that large-scale storage must be available to hold the off-peak production so it can be marketed quickly during peak loads that will be greater than his current production capacity.

Fortunately a solution of this problem appears to be in the making. In the past and in some degree yet, large amounts of propane and butane have been stored in depleted oil and gas sands until such time as they may be re-recovered and marketed. This is a partial solution, but its value is lessened by the facts that recovery of the stored material is uncertain and when drawn from the ground must be reprocessed to meet market specifications.

A more recent and more promising solution is that of storing light hydrocarbons in water sands or in huge cavities leached out of salt deposits. Chicago Corporation stores propane in water sands, as in its Carthage, Texas, venture, which shows good results. More recently Warren Petroleum Corporation, Sid Richardson Gasoline Company and others have solved the problem, it appears, by circulating water in large quantities through salt domes, dissolving

EXCLUSIVE

*Editor, Refining and Gas Processing.

out immense caves in the salt into which propane and butane are pumped to await their removal to satisfy market requirements. In this case the product is recovered in its original state, meeting specifications to which it was made, or practically so.

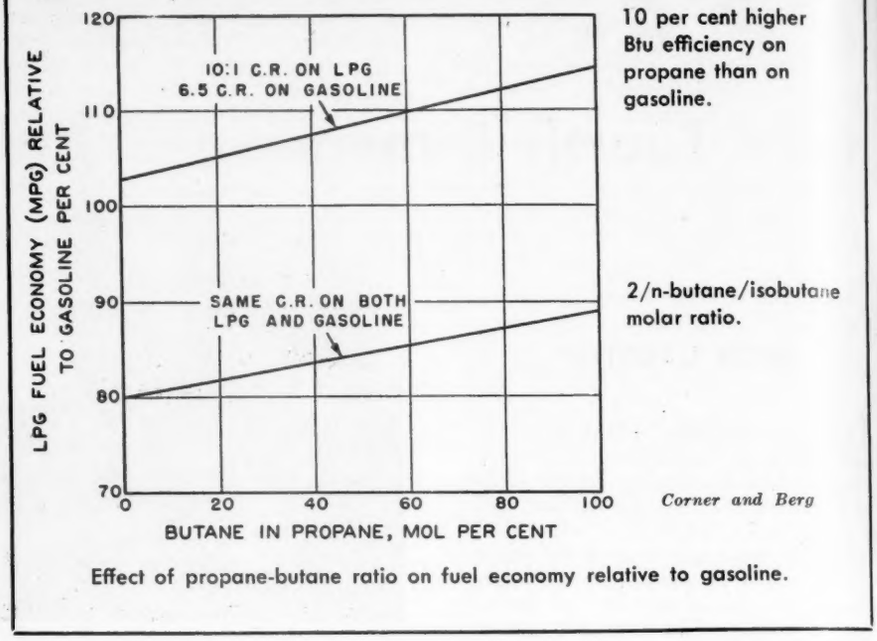
Probably not enough data are available regarding installation costs for leached-out salt dome storage, under widely varying conditions, for the "experts" to become dogmatic about these values. Felt states that by cutting a shaft through a limestone caprock and removing a stratum of shale by a "simple mining operation a reservoir was formed to house 25,000 bbl of LPG." He believes that costs on underground storage may be held within a $2.50 to $1 per bbl range, depending on the size and geological circumstances, as compared to $20 per bbl for steel storage.

Frank Matheny corroborates the $20 per barrel "or nearly 50 cents per gallon" for steel storage, stating further, "And considering propane values, there is not a whisper of a hope ever to effect a payout on money so invested." He cites the experience of La Gloria Corporation in storing butane in a 5500 ft inactive gas reservoir, where with 20 per cent porosity 20,000 bbl of butane were stored; 62 per cent was recovered by flowing at the end of a withdrawal season and the unit was still flowing. Matheny indicates that a 100,000 bbl reservoir might go in West Texas for $50,000 or 50 cents per barrel, or 1/42nd of the steel storage cost; similarly, a larger unit, as 500,000 bbl adjacent to the Mississippi, could go in for 15 cents per bbl, a 70 per cent reduction in the per-barrel cost from the reservoir 1/5th as large. Not all porous media are successful, he says, as "Millions and millions of gallons have been pumped into the granite wash of the Texas Panhandle, with almost instantaneous migration," that is, to all purposes lost to the original producers.

TABLE 1.—LP-gas and gasoline in petroleum reserves.
(Alden-Gilmore-Tucker)

	December 31, 1940	December 31, 1950
Reserves:		
Crude oil (billions of barrels)[a]	19.0	29.5
Natural gas (trillions of cubic feet)	85	185
Gasoline[b] in reserves (billions of barrels):		
In crude oil (42.5-per cent yield)	8.1	12.5
In natural gas (0.8 gal per 1,000 cu ft)	1.6	3.5
Total	9.7	16.0
LPG in reserves (billions of barrels):		
From refining of crude oil (12.5 per cent)	2.4	3.7
In natural gas (2.3 gal per 1,000 cu ft)[c]	4.7	10.6
Total	7.1	14.3
Ratio of LPG to butane-free gasoline	0.73	0.89
Ratio of LPG to gasoline with a Reid vapor pressure of 10 lb.	0.65	0.81

[a]Includes natural-gas liquids.
[b]Butane-free gasoline.
[c]Includes LPG in natural-gas liquids.



Effect of propane-butane ratio on fuel economy relative to gasoline.

Uses for LP-Gas

In addition to domestic and industrial heating as outlets for LP-Gas, large amounts of butane—but *no* propane—are utilized to add volatility to motor fuel. This quantity it appears will remain constant at some 6 per cent of the motor gasoline marketed. This amounted to an estimated 168,000 bbl per day during 1950, average. Therefore increase in butane consumption by this route will proceed at about the same rate as does the increase of motor gasoline consumption, and will affect the total LPG consumption in a not too important degree. Similarly, consumption of butanes for rubber-making, for alkylation, and such special products will increase only with increased demand for those products a reasonably certain but relatively slow climb.

As indicated earlier herein, one of the fields in which the use of LP-Gas can grow, and is growing, most rapidly is in its use as direct motor fuel. Given enough installed fuel systems to use propane or butane or mixtures, it is easily understood that in event of war, when a large part of our motor fuel supply must go inevitably to military uses, LPG can easily make up the difference and avoid the necessity for rationing of "heavy" gasoline to civilian uses and thus help to maintain our maximum production, our everyday living status.

It has been estimated that 100,000 LPG fuel systems will be installed in this country in 1951, and that the number will increase greatly in 1952 and succeeding years. Already large numbers of farm tractors, buses and trucks, and various stationary power plants are operating on LPG. Distribution is still a factor in many instances, especially if cross-country runs are planned, but this can be and will be corrected as was the case with motor gasoline more than 40 years ago.

Some idea of the relative efficiency of propane-butane as compared to motor gasoline is seen in the accompanying chart, which shows the effect of propane content on the LPG efficiency, and the efficiency of LPG compared to motor gasoline. It is seen that at 10:1 compression ratio for LPG and 6.5:1 for gasoline, the mileage efficiency with straight propane is 103 per cent of that of motor gasoline, increasing to about 114 per cent for pure butane. While the higher vapor pressures of LPG necessitate pressure storage in vehicles, and special arrangements for carburetion and handling, these are not prohibitive obstacles and have been overcome almost completely.

To supply truck, bus, tractor, and similar commercial outlets with LPG Alden estimates that we will require about 45 per cent of the volume of motor fuel supplies. If LPG captures half this market in 10 years it is the equivalent of 20 per cent of our total motor fuel production, or will supplement our crude supplies, on the basis of gasoline production, by 20 per cent. Thus, at 5,500,000 bbl crude demand per day, this use of LPG will be equivalent, in motor fuel, to the addition of more than a 100,000,000 bbl of crude per day to our runs, without drilling a single additional well or refining a single additional barrel of crude.

Also, another item of importance, which is having great effect in inducing users to install LPG fuel systems and use this fuel, with retail LPG prices at 9 to 10 cents per gallon, and four to five cents fuel tax for that consumed on the highways, the total price for LPG motor fuel in trucks, buses, and cars is only 3/5th as high as that of housebrand motor gasoline. In the opinion of qualified authorities in the industry, we may look to LPG to solve much of our problem of increase in motor fuel demand, whether war or peace prevails in the world.

* * *

Aerial view Montreal East lubricating oil and grease processing plant of Canadian Oil Companies, Ltd.

P 738.

Ultra Modern Canadian Lubricant Plant

Latest processing methods and efficient mechanical device mean push-button control of one of the world's most unusual refineries

HARRY CHAPIN PLUMMER

NEW to Canada and reputed to be the third of its kind in existence anywhere in the world is a lubricating oil and grease-blending plant, completed and opened at an outlay of $2,000,000, by Canadian Oil Companies Limited at their big Montreal East refinery. The latest addition to operations at that formidably strategic site presents a unique companioning of ultra-modern technological processing methods with the most up-to-date and efficient mechanical innovations and devices. Either one of those two productive phases would be recognized as a noteworthy departure in plant engineering advance. But their combination in a veritable "push-button control" unit marks a trail-blazing achievement in the petroleum refining industry.

Ocean and Lake Ships Dock at "Tank Farm"

The layout on refinery premises distance only six miles from downtown Montreal and occupying 13 acres of riverside ground, is bounded on its south side by the navigable frontage of the St. Lawrence and on the north by Notre Dame Street, one of the city's most frequented motor-traffic arteries. Ocean-going oil-tankers and cargo-carriers and those from the Great Lakes and their canal approaches dock with equal facility before 39 storage-tanks ranging in capacity from 350,000 gal down to 9000 gal. The "tank farm," in turn, is the focal point of a network of rail trackage connected with the Canadian transcontinental systems by the harbor-belt-line railway of the National Harbors Commission.

Such is the degree of co-ordination of the distinctive industrial chemical processes and the mechanical auxiliaries that complement and facilitate them that only by a series of photographs and flow-tracing it is possible to convey an idea of the magnitude and scope of operations and their compassing within a well-ordered production unit. As will be

EXCLUSIVE

General frontal view of plant. Structure (lower left) was built during World War II.

Header manifold of base stock routing system. On left, maze of delivering lines from valves through which blending stocks are brought in from tank farm, with separate line from each tank. On right, proportional homogenizer and pumps which finally place oils in finished inside filling or process storage.

demonstrated pictorially, the oil-blending section presents an automatic blending installation novel in Canadian refinery technique. Oils are put together under such violent agitation as to produce homogenizing conditions. As a result, the dispersion of additives and other blending materials will be improved markedly and will be reflected in higher quality in lubricants.

Homogenization Results from Violent Agitation

Specialized equipment installed in the grease manufacturing section effects the violent combination of ingredients under pressure and/or vacuum and high temperature in meticulously controlled systems.

From the "tank farm" blending stocks are brought in through a maze of delivering pipe lines and valves to the header manifold, or base routing system. There is a separate line from each tank. Hose connections are made from the tank outlets to pump manifold, the proportioning homogenizer. Certain pumps pick up from there, to finally place the oils in finished inside filling or process storage.

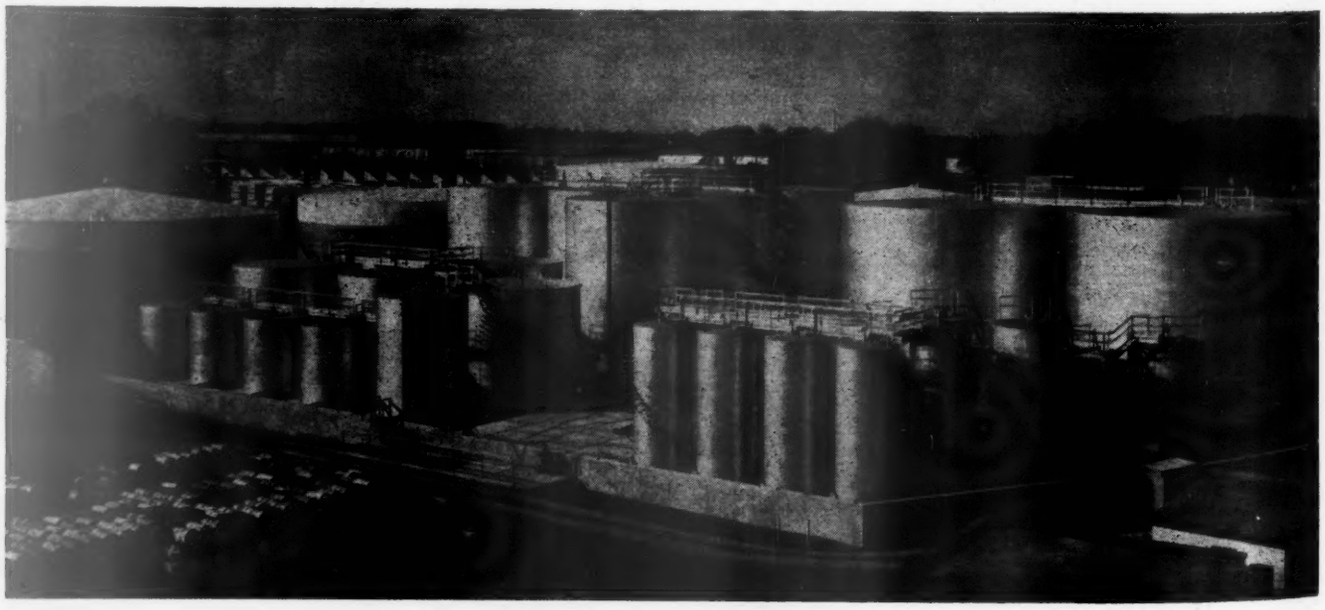
Grease Making

To the automotive and heavy industries the word "grease" signifies very specialized products used for lubrication where liquid oils are not adaptable. Many services must depend upon lubricants that will "stay put," day in and day out, without continuous attention. Extremely diversified services require, in some instances, lubricants having exceptionally high melting points; in others, very excellent low temperature performance characteristics, as in refrigeration and aviation mechanisms. In simplest form, greases are jelled lubricating oils; the jellying agent being usually a soap or combination thereof. The soaps are chemical combinations of metals, fats and/or fatty acids. They vary widely, according to the metal and/or fatty acid used. Some greases are short-grained, smooth, unctuous, or buttery in nature. Others are coarse-grained, stringy and fibrous.

Evidencing the "push-button control" feature is the automatic assembly. In that, claimed to be Canada's first establishment in the art of systemized blending and compounding techniques, all motor oils and many industrial lubricants are marshalled. A proportioning cabinet balances acccurately the base materials up to six ingredients that go to make up the scientifically developed "White Rose" formulae.

Canadian Oil Companies Limited, of which W. H. Rae is president, has its principal offices at Toronto. E. A. Smith, manager of manufacturing, maintains his headquarters at Petrolia (Sarnia), Ontario, where a multi-million dollar COCL refinery is under construction. When completed in the coming year that new plant will process Alberta crude oil brought by Lake tankers from the Interprovincial Pipe-Line terminus at Superior, Wisconsin.

Outside storage to keep plant supplied with blending-stocks comprise 39 tanks ranging from 350,000 to 9000 gal.



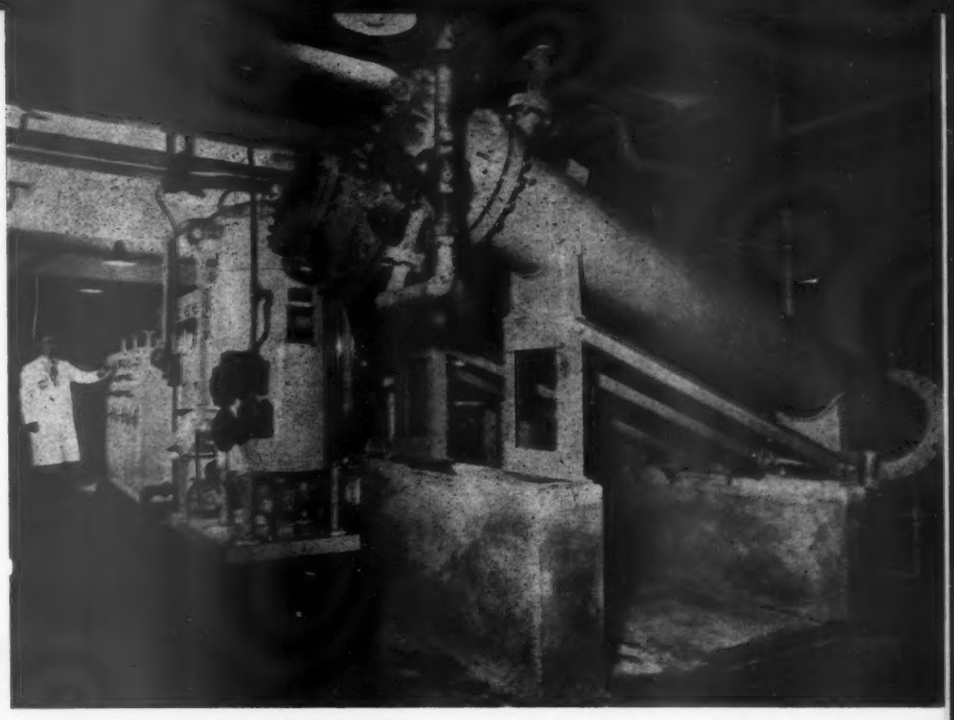
The precisely assembled materials pass from the proportioner to the heater through a filter and thence to the homogenizer, the third unit in the process. Following, the ingredients are driven turbulently together under homogenizing conditions, to form uniform stable oils. All traces of moistures and air are disengaged and removed in that vacuum process; the oil then passes to a cooler and on to filling storage.

Under such clocked treatment, all ingredients "stay put" in solution. Detergents, oxidation, and corrosion inhibitors are so effectively dispersed in solution that they are more free to perform their specific functions with maximum efficiency. As a result of the new processing, homogenized oils will not separate or stratify under any conditions existing either in storage or in the ultimate lubricating of internal combustion engines.

The inside filling, storage and process tanks total more than seventy. Each of those is divided into four compartments, all equipped with steam-heating coils and some with mixing devices. Certain products that require only preliminary or intermediate mixing are prepared in such limited types of vessels.

Grease making, an art as well as a science, requires precision methods and technical control to produce the multitudinous types of lubricants demanded. The equipment used in the manufacture of such products is highly specialized.

The contactors, closed vessels that operate at high temperatures and pressures, are equipped with high-speed impellers, motor-driven through the bottoms of the vessels. The impellers agitate the contents to extreme turbulence. In the contactors are made the soaps and other jellying agents, to be later transferred, under pressure, to pressurized mixers.



Motor oils and many industrial lubricants marshalled on this automatic assembly. In background, proportioning cabinet which accurately apportions up to six ingredients, the basic materials making up formulae, which pass thence to heater (in foreground), where components are violently driven together under homogenizing conditions.

The vats or mixers are equipped with countercurrent scraper-blades and mixing paddles. The interior surfaces of the vessels have been engine-turned and scraper-blades constantly remove the grease from the walls before it has had time to jell prematurely.

Petroleum oils are mixed into the soaps in the vessels and the grease product, all through the process of manufacture, is maintained in a semi-fluid or plastic condition. It is allowed to jell fully only after it has arrived in containers.

Most greases have a tendency to thin or lose consistency when introduced to the violent working, pounding, or agitation of the bearings they are meant to lubricate. A colloid mill is used to prework greases or break them in, so that they are fully conditioned and "tem-

Labyrinth of machines co-ordinated to operate as synchronized unit in can-filling operations, beginning with removal of cartons of cans from conveyors to "unscrambler," which automatically feeds empty cans to high-speed fillers. Thence to automatic closer, sealing filled cans, which traverse conveyor and elevator, to be delivered to packers.

Complex arrangement of piping, valves, and meters. Automotive oils and many industrial lubricants flow from inside process supply tanks through meters delivering products into drums.

In different type of can-filling operation overhead conveyors feed Imperial 5-gal pails to high speed multiple filler, conveyed thence to semi-automatic closer. Filled and sealed containers received onto pallette and moved by lift-truck to pallettized storage. Background reveals copious use of conveying systems.

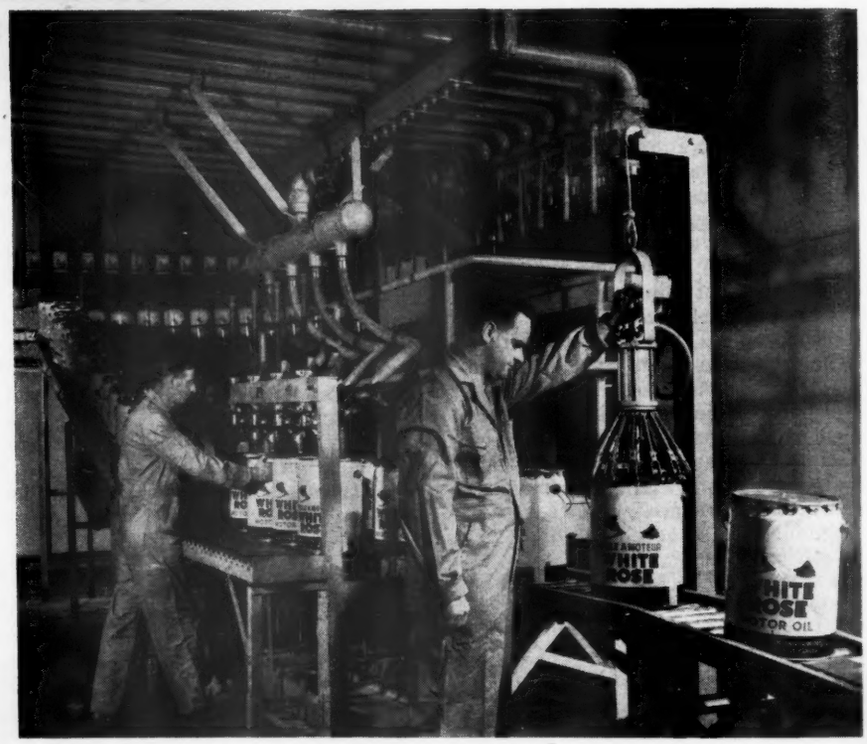
pered" for the lubricating service for which they were designed.

Before going to containers, greases are pumped at high velocity through the close-set spinning-disks of this mill. The mill is also equipped with a de-aerating device to free the product of entrained air bubbles, which are conducive neither to good appearance nor to proper performance. This type of equipment is employed for the first time in Canada.

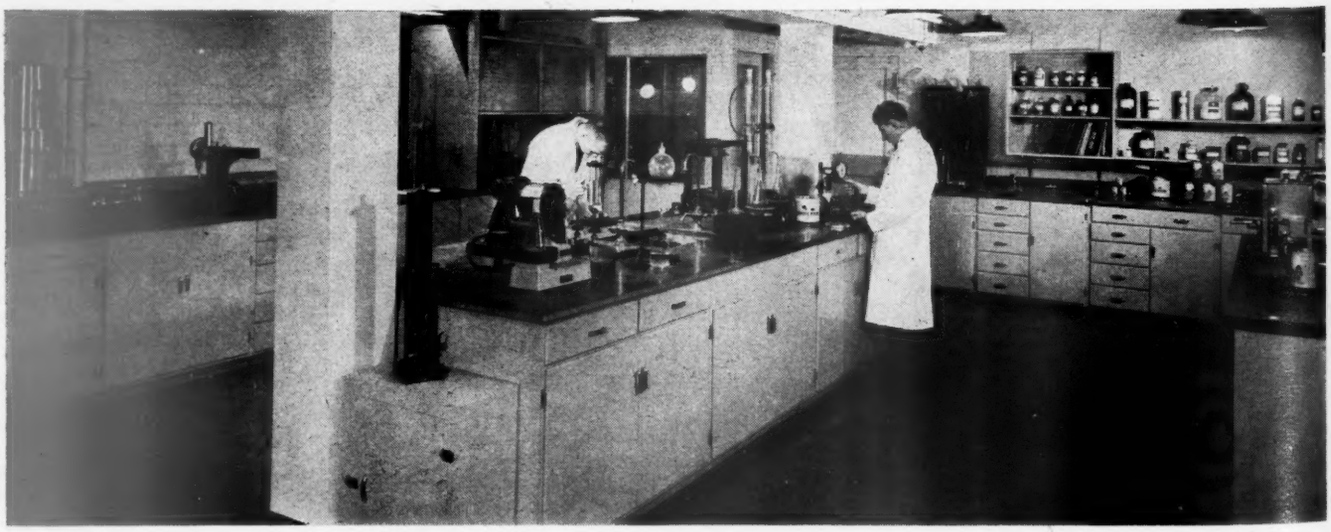
Re-Condition Drums to Conserve Steel

As an organic contribution to the chemical phases of the oil-blending and grease-manufacturing "production line," the canning and conveyor functions utilize emptied and one-time discarded containers after thorough sterilization. The operation conforms to the exigencies of "cold war economy." The acute shortage in Canada and in the United States occasioned by the defense program, now renders imperative the studied conservation of steel materials in service. So the companies have installed a modern and complete drum reconditioning department, in order that steel drums can be cleaned repeatedly and restored to use.

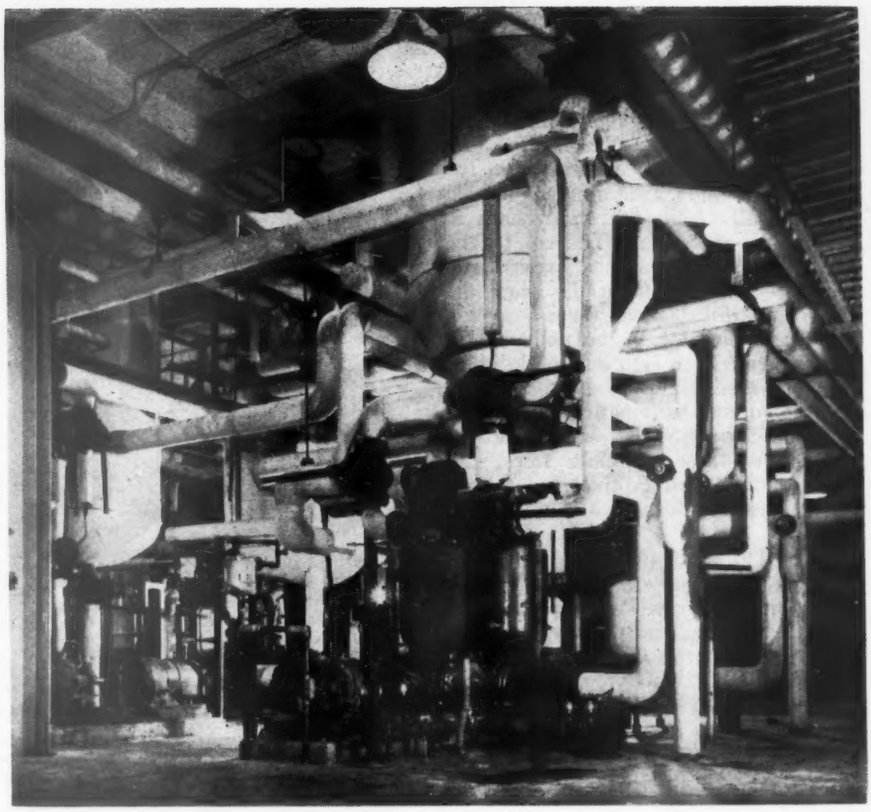
Through the drum-conveyor system and delivery and preparation corridors



Some of various types of instruments and equipment on benches in control laboratory.



At right and below—Diversified services for lubricants having extremely high melting points or excellent low temperature performance characteristics—the jellying agent usually a soap or chemical combination.



the drums are received from outside drum storage or direct from box-car or motor-transport. A lately developed, new type of rotary de-denter, outside stripper and buffer, with the aid of suitable chemical and detergent solutions, strips and buffs off old paint. Washing and rinsing operations follow on outside and the drums are then moved by conveyor to "inside wash and rinse," where the interior surfaces of the drums are similarly treated.

Foreign Matter Removed by "Drum Chainer"

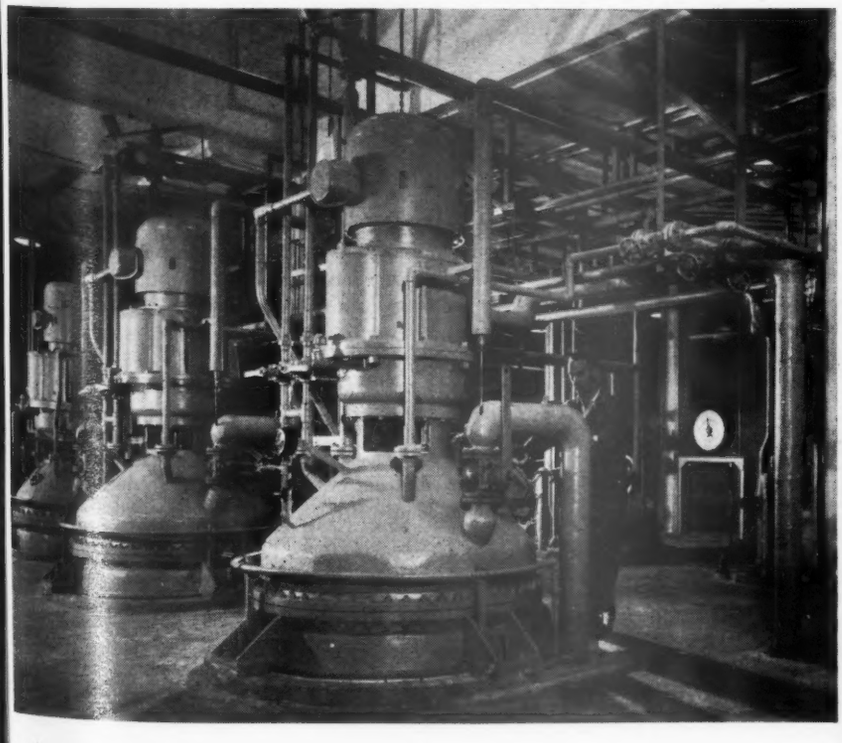
An important intermediate unit in that operation is a "drum chainer," which buffs the entire inside surfaces; aided by the introduction of a cleaning solution and several lengths of special chain made up of sharp-edged links. By that mechanism the drums are rotated at high speed in different positions, thus insuring complete cleaning.

A leak-testing unit applies air-pressure as the drum is rotated in a water-bath. A strong light shining up from the depths of the tank promptly reveals the slightest leak. Upon discovery, leakers are forthwith sent to the drumwelder if otherwise the condition of the drums warrants further service. An automatic chain-roller receives the drums by conveyor from the dryer. It is a mechanism that effectively straightens the ends of the drums where heads join bodies and also reseals the joints, thereby insuring against leakage upon re-use. Steel plugs employed in the final sealing of the drums are scrubbed, buffed, and rinsed.

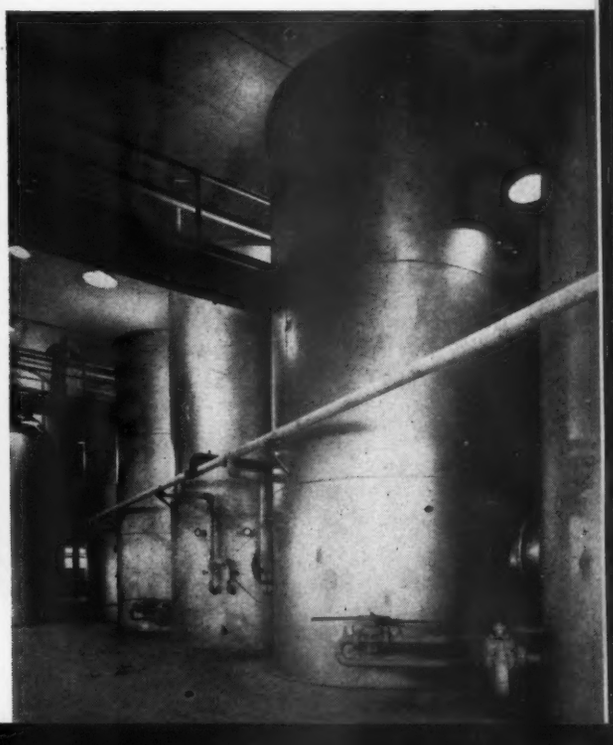
Upon emerging from the paint-dryer, after treatment in the paint-spraying booth, and entering the cooler, the drums are subjected to high velocity air-circulation as a cooling process. Spray-gun stencilling, some necessary stamping and the application of transfers, when necessary, are final stages in the re-conditioning work. Last, the drums are weighed for tare. Inasmuch as the standard metered gallonage is already known, they are stencilled with their gross weight. By conveyor from the stencilling booth the drums are soon migrating to the filling points or to storage.

Spiral Chute Facilities Inter-Operation Transfer

Efficient use has been made of modern types of transfer and conveying equipment. A multi-purposed spiral chute is utilized for the transfer of packaged grease products from the second floor to the shipping plant and packaged empty



Inside filling, storage, and process tanks, apparently six in number, but actually 24, each divided into four compartments, each equipped with steam-heating coils.



cans from the third floor to the high-speed can fillers.

One of the most impressive operations in can-filling technique consists of a veritable labyrinth of machines coordinated to function as a synchronized unit. The continuity begins with the removal of the cartons of cans from the conveyor to the "unscrambler," which automatically feeds the empty cans to the high-speed fillers. Thence, to the automatic closer, which hermetically seals the cans of motor-oil. From the closer, the filled cans traverse a conveyor and elevator, to be delivered to the packers. Then into automatic gluer and compression unit, where the cartons are sealed and automatically stamped with the correct S.A.E. designation.

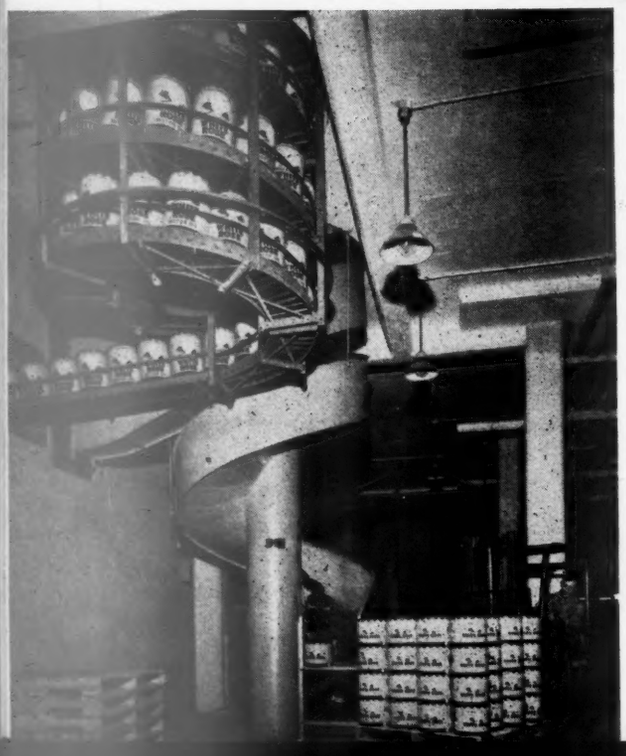
Many of these machines were supplied by Stratford Engineering Corporation and by Cornell Machine Company.

From that point the conveyors deliver the cartons to palletized storage. The operation is regarded as the ultimate in high-speed filling and packaging equipment, filling more than 18,000 Imperial quarts per hour with precision and accuracy. Said to be the highest speed oil-canning line in Canada, it was installed to provide for the increasing demand for COCL products.

Filled Drums Pass Over Power-Driven Rollers

In another type of can, filling operation, overhead conveyors feed Imperial 5-gal pails to the high-speed multiple filler and thence, by conveyor, to the semi-automatic closer. The filled and hermetically sealed containers are received onto pallets at the end of the delivering conveyor and are moved on by lift-truck to palletized storage.

A third adaptation of modern conveying methods passes filled drums over power-driven roller conveyors to the delivery point, where the forks of a lift-truck, in one operation, lift four drums at a time and whisk them to palletized storage. The Fluor Corporation designed and built this plant. * * *



Top—Before going to inside wash and rinse, drum-chainer (right foreground), buffs entire inside surfaces. Cleaning solution and several lengths of special chain composed of sharp-edged links are introduced into drums. Machine violently rotates the drums at high speed in different positions. In immediate left foreground a leak-testing unit. Air pressure applied and the drum rotated in a water bath, a strong light shining up through latter revealing the slightest leak. In left background, automatic chime roller receives drums by conveyor from the dryer. It effectively straightens the ends of drum where heads join body and re-seals the joint, thereby avoiding leakage. In middle foreground, steel plugs are scrubbed.

Center—Drums emerging from paint-dryer and entering cooler, shown left foreground, where dried and cooled by high velocity air circulation. In far background, semi-automatic spray-painting booth.

Multi-purpose spiral chute, background, transfers packaged products from second to shipping floor and packaged empty cans from third floor to high-speed fillers. Spiral roller conveyors show empty 5-gal cans en route to filling line.

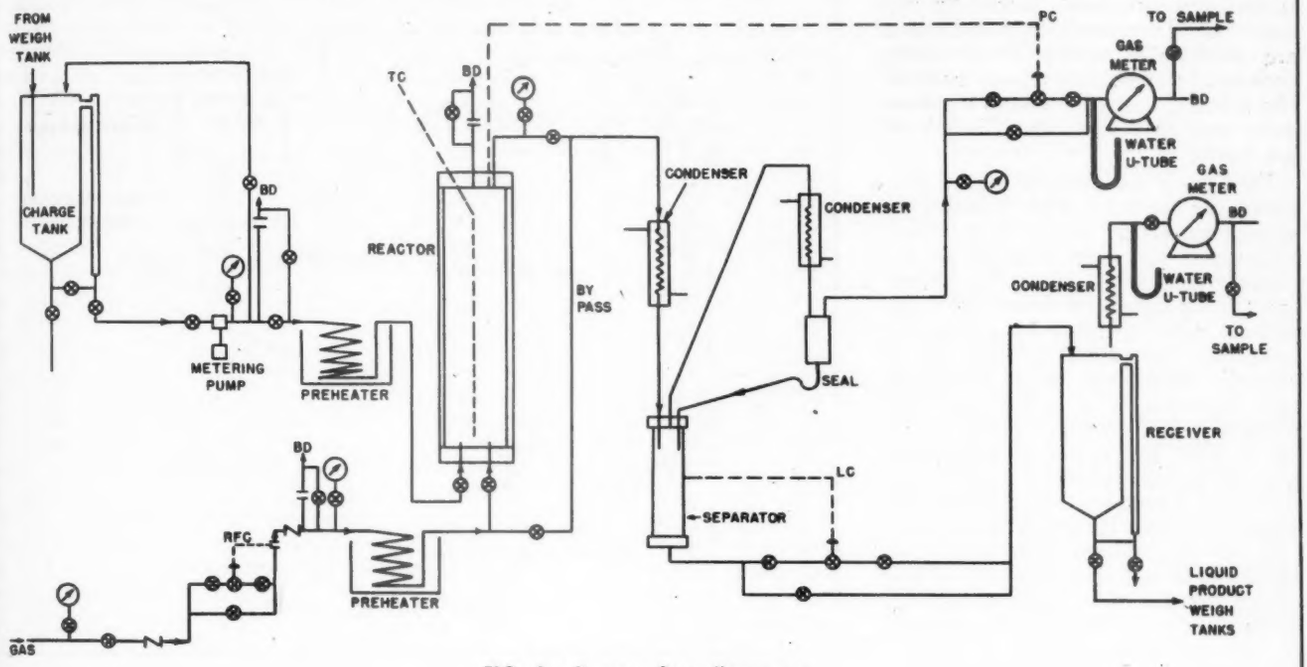


FIG. 1. Process flow diagram.

PILOT PLANT DESIGN†

The utmost in control and inspection is required in bench scale pilot plants—General requirements are discussed here.

B. M. WEDNER[1], W. A. HORNE[2], T. P. JOYCE[3]

SMALL pilot plants, used in a large number of laboratories, are generally termed bench-scale pilot plants because of their size. These units are primarily intended for exploratory research to investigate new ideas, but they also serve to obtain sufficient chemical and engineering data to design a larger scale development pilot plant, which in turn provides the necessary firmer chemical and engineering data required for the design of a commercial plant. Thus, these bench scale units are one of the necessary stages in the orderly development of a new process. Their importance may be further emphasized by pointing out that the decision to continue development of a process frequently depends on the preliminary economics calculated on the basis of the results of these small scale units in conjunction with a commercial chemical engineering design.

Bench-scale pilot plants are not normally constructed to be replica or demonstration plants but to incorporate the principles of maximum flexibility and general utility in order that a variety of reaction types may be studied and a wide range in operating variables investigated. Care must be observed in their design and construction so that losses are minimized and representative results obtained. At the same time maximum ease and practicability of operation, modification, and examination of equipment or catalyst should be provided. In these units relatively unknown reactions are being investigated, and the utmost in control and inspection is required as a safety precaution.

The purpose of this paper is to describe briefly the process flow and construction of the general type of bench-scale pilot plant we use in the 500-6000 psi pressure range and discuss the mechanical design methods, materials of construction and inspection, testing, and safety considerations. Units of this type have been used for preliminary studies on the processing of chemical immediates and petroleum fractions from naphthas to reduced crudes. The hydrogenation of high sulfur stocks and residual tars in continuous and cyclic operation may be cited as a specific application.

Unit and Process Flow

The essential elements of a typical bench-scale pilot plant are the feed system, reactor assembly, and recovery system. The major components of these elements and the essential auxiliaries associated with them will be described. A discussion of the minor auxiliaries common to all units regardless of pressure have been omitted.

A process flow diagram of a typical unit is shown in Fig. 1. Liquid charge is pumped into the unit by a proportioning pump with double inlet and out-

†Presented before the American Society of Mechanical Engineers' Petroleum Mechanical Engineers Conference, Tulsa, Oklahoma, September 24-26, 1951.

[1]Equipment design engineer.
[2]Assistant head, process chemistry section.
[3]Research chemist, Gulf Research and Development Company, Pittsburgh, Pennsylvania.

let check valves. The rate of liquid flow is measured and spot-checked by volume. The charge tank lines and pump are electrically heated if necessary, such as when feeding a viscous material like reduced crude. Flow rates for these units may be varied from 75-4000 ml per hour.

Feed gases are pumped from atmospheric gas holders to 5000 to 10,000 psi storage vessels by means of a 5-stage compressor and then reduced to approximately 500 psi above the desired operating pressure by means of a diaphragm valve operated by a pressure controller. The desired gas flow rate is normally maintained by a diaphragm valve operated by an orifice-type electronic flow controller. For gas pressures up to 3000 psi, however, satisfactory flow can be maintained by manual control using a rotameter. In this case the supply gas flows through a dome operated reducing valve to an armored rotameter and is controlled manually on the downstream side by a needle valve, Fig. 4. For satisfactory operation a minimum of 100 psi pressure drop is recommended across the needle valve. This method has the advantage of cheapness, ease of calibration, and small space requirement; it is limited only by the availability of satisfactory reducing valves and rotameters. Regardless of the method of flow control, we have established the practice of a check calibration prior to each experimental run. Automatic ball check valves have not proved successful as a protection against broken lines downstream from storage vessels. The oxygen content for explosive gases is checked continually and automatic cut-offs are installed on gas compressors if the suction pressure drops to 4 in. of water. This prevents air being drawn through an open drain valve or a leak in the intake line.

The preheaters are generally coils immersed in a lead bath that may be mounted at the top or bottom of the reactor depending on the type of operation, up or down flow. The liquid and gas may be preheated separately as shown in the figure or alternatively a single preheater may be used for combined feed. With a properly designed coil and a short well insulated transfer line, coking is not normally a problem but salt may cause plugging when charging residual stocks, and the coil must be steamed out at the first indication of pressure drop. In some special cases, a series of lead baths may be required in order to preheat at a more commercial rate. An alternative method of preheating is that in which a portion of the reactor or a separately heated vessel is packed with quartz, stainless steel balls, or some other inert material as a transfer medium.

The combined liquid and gas charge flows from the preheaters to the reactor vessel. The reactors are machined from stainless steel forgings and are provided with either a plug or compression head type closure depending upon the size and operating pressure. In some cases

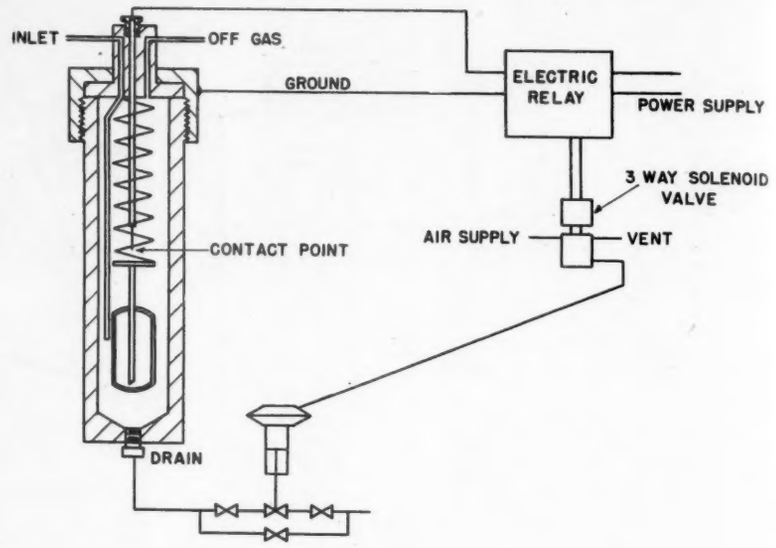


FIG. 2. Liquid level controller.

closures are welded to the ends of seamless tubing, if the generally heavy wall of a forged and machined vessel is not required. The types of closures used are discussed further under reactor design. The volumetric capacity of the reactors varies from 500 to 4000 ml. It is recommended that lead baths and reactors be protected from overheating in the higher temperature range.

The reactors are inserted into furnaces that are usually of extra length to compensate for the end effects. Two types of furnaces are normally used. The most general for applicability when studying endothermic or exothermic reactions is stainless steel tubing wound with multiple heaters. By proper adjustment of heating elements reasonably close control of the temperature can be obtained throughout the length of the reactor. The second type furnace consists of an electrically heated heavy walled aluminum bronze casting that has been machined to fit the reactor. This type has a large heat capacity and gives a relatively isothermal condition. Where a heat balance is required, the heating elements are wound directly on the electrically insulated reactor. The heat input is adjusted so that there is no difference in insulation and reactor thermocouple readings and the reactor operates adiabatically. In special cases the reactor may be inserted in a heat exchange salt bath or jacketed and heated by means of boiling liquids under a controlled nitrogen pressure.

The products from the reactor pass through a condenser to a high pressure separator. The gas from this separator flows through a secondary condenser and trap where additional lower boiling material is condensed and returned to the separator or collected in a receiver. The gas is reduced to atmospheric pressure by a diaphragm valve operated by the pressure controller and flows to absorbers, scrubbers, gas meters, and sampling devices as necessary. The liquid phase is removed from the high pressure separator by means of a level control valve.

The vessel used as a high pressure separator may conveniently be constructed in a manner similar to the reactor and a level control built into it. In fact we frequently use reactors that have been taken out of high temperature service, as a safety precaution, after a few years use. We use three types of level controller, all of which will control the liquid level in the separator to 1/16 in.

For materials that do not deposit solids, a spring loaded stainless steel float may be built in the separator to make and break an electric circuit; an electronic relay operates a three-way air solenoid valve which in turn operates a diaphragm valve. An illustration of this type controller is shown in Fig. 2. A photo electric cell used in conjunction with a sight gage can also be used in a similar manner to control the liquid level. An illustration of this type controller is shown in Fig. 3. The diaphragm valve stem in the above two methods is adjusted to prevent excess surge of the liquid. Pneumatic level controllers are also used, but these require diaphragm valves with exceptionally good flow characteristics for small flow rates and therefore are more expensive and have the disadvantage that they tend to plug rather than being self-cleaning. The low pressure lines from the level controllers and pressure controllers are protected from high pressure surges by a "U" tube filled with water or oil.

The gases from the separator are sometimes recirculated to the reactor on larger units. Control of flow is difficult unless an elaborate gas scrubbing system is used to eliminate check valve

difficulties. These pumps may be designed to a refrigeration-type compressor or in some cases a bellows type. For smaller units recycle gas blends are mixed in a gas holder equipped with an internal fan, compressed into storage vessels and recycled to the units.

High pressure storage vessels, the downstream side of liquid pumps, gas flow controls, and reactors are equipped with blowout discs and manual blowdown valves. A daily check is made on the gas pumped and consumed by the units. This system has helped to determine leaks, faulty valves and to make the personnel safety conscious. Units are pressure tested to 1½ times the working pressure periodically and at such times when major repairs have been made. Units are also pressure tested to working pressure prior to each experiment.

These units are readily accessible and practical from an operating viewpoint and adaptable to a wide range of operating conditions. To attain the desired objectives the best possible control must be incorporated. If automatic controls result in too great a time delay or are not adaptable to the scale of the plant, hand control is most satisfactory. Once built, the most essential factor in obtaining reliable results is extreme care and attention by the operator.

Design of Pressure Equipment

The design of all pressure containers, reactors, and piping used on the bench size pilot plant follows the requirements for pressure vessels that have been established for use at our laboratory. In accordance with past experience and to meet insurance requirements, all pressure vessels are designed in accordance with ASME Code for Unfired Pressure Vessels. In some cases, where samples under high pressure are transmitted by public carrier from outside points to the laboratory, the containers must also be in accordance with the ICC Regulations for Containers in Inter-State Shipment.

There have been reactors, which, because of extreme conditions in temperature and/or pressure, could not be designed to the ASME Code and obtained a satisfactory design because of the extremely heavy wall required for safe allowable working stresses. In some cases the use of a safe working stress allowed by the ASME Code was too low to give a workable design. Where this has occurred the case has been treated as a special one and the design worked up using working stresses outside the code but restricted in accordance with our past experience and with special provisions for fabrication, with extreme care in setting up safety precautions for handling the reactors, and with rigid requirements for pressure testing and inspection.

In such special cases we have designed on the basis of the yield strength of the material used for the vessel. In general, the design in such cases has been based on having the working pressure for the vessel such that when the vessel is tested in accordance with ASME Code the stress obtained under the hydrostatic test pressure will be just below the yield point for the material. Allowance for temperature is made as required by the code for temperatures exceeding 650 F in determining the maximum test pressure.

In such special cases we have also taken care to assure that the design avoids all possibility of stress raisers, in the form of sharp fillets and surface imperfections, and we have required that the steel used in the reactors have *minimum* physical properties in excess of those used in making the calculations. We insist on certification of these physical properties by the steel supplier.

Although the number of such cases have been few and it would not be entirely feasible to draw any specific conclusions from our experience, we believe that our practice of following the general rule of designing to the ASME Code, treating all cases outside the code as special ones, requiring greater precautions in design, fabrication, and testing, has given a safe and reasonable procedure in the design of vessels for high temperature and pressure.

On three occasions compression head closures have failed. A thrust plate failed when heated above its maximum temperature range and caused an immediate fire. In the second case the cap was screwed on tight so that the underside of the cap was in direct contact with the pressure plate and upon heating the gasket surface of the reactor relieved due to differential expansion. The reactor was made of 347 stainless steel, and the compression cap SAE 1141 (AISI No. C1141). If the cap had been positioned so that the bolts extended through it when tightened, they would have relieved as they are designed to do, Fig. 7. The third case of failure was the compression cap made from 322 stainless steel which cracked as shown in Fig. 8.

The broken cap had a Rockwell C hardness of 52 instead of 47 maximum. The design of the cap was poor in that there were some sharp fillets at the point of failure. Fortunately the failure occurred when the cap was tightened prior to heating and pressurizing the vessel. A previous crack can be seen in the photograph. As a safety measure all caps are now checked by the high frequency sound wave method to make sure they are free of flaws.

In the design of vessels for use at high temperatures and high pressures, consideration must be given to the type of closure that is used. For the reactors of the size used in our bench-scale pilot plant, two types of closures are used, the compression type, Fig. 5, and the Bridgeman or plug type, Fig. 6. We have used both successfully, but as the working pressures go beyond 5000 psi

FIG. 3. Liquid level controller.

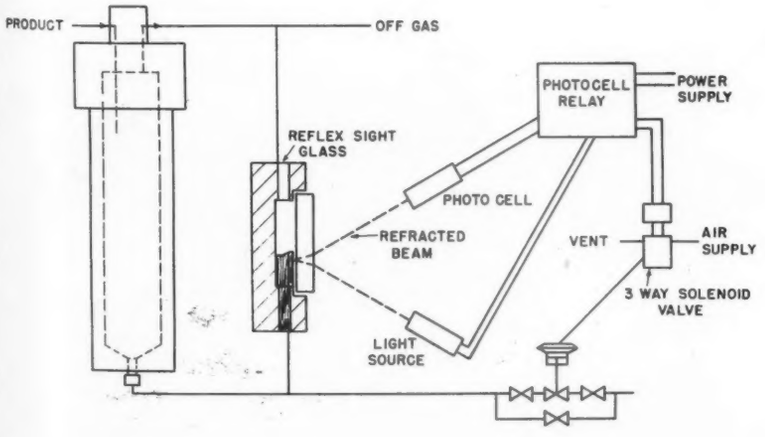
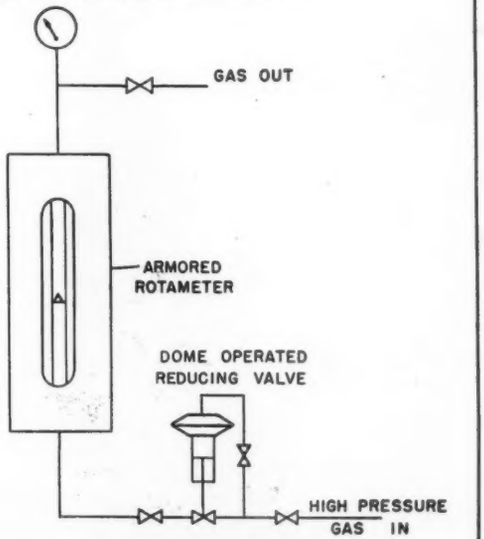


FIG. 4. Gas flow controller.



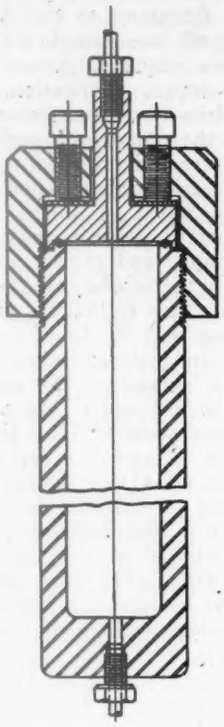


FIG. 5. Compression head type closure.

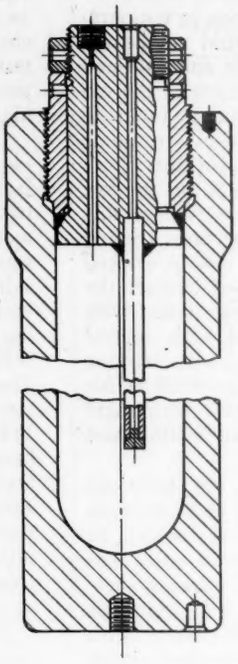


FIG. 6. Bridgeman or plug type closure.

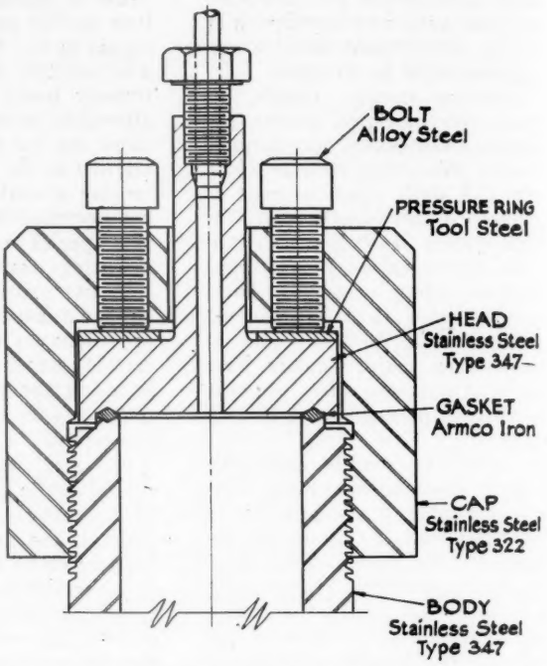


FIG. 7. Compression head-type design, which may be subject to failure of the seal caused by differential expansion.

and the working temperatures go to 1000 F the plug type with its self-sealing due to internal pressure seems more advantageous.

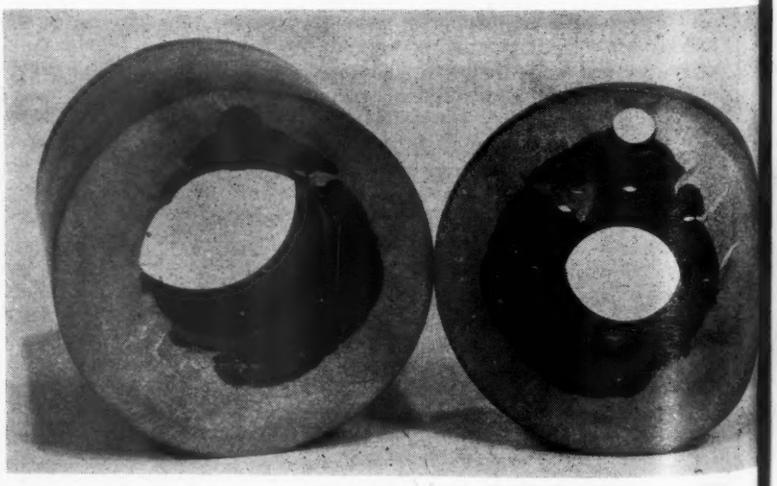
Selection of Materials for Pressure Equipment

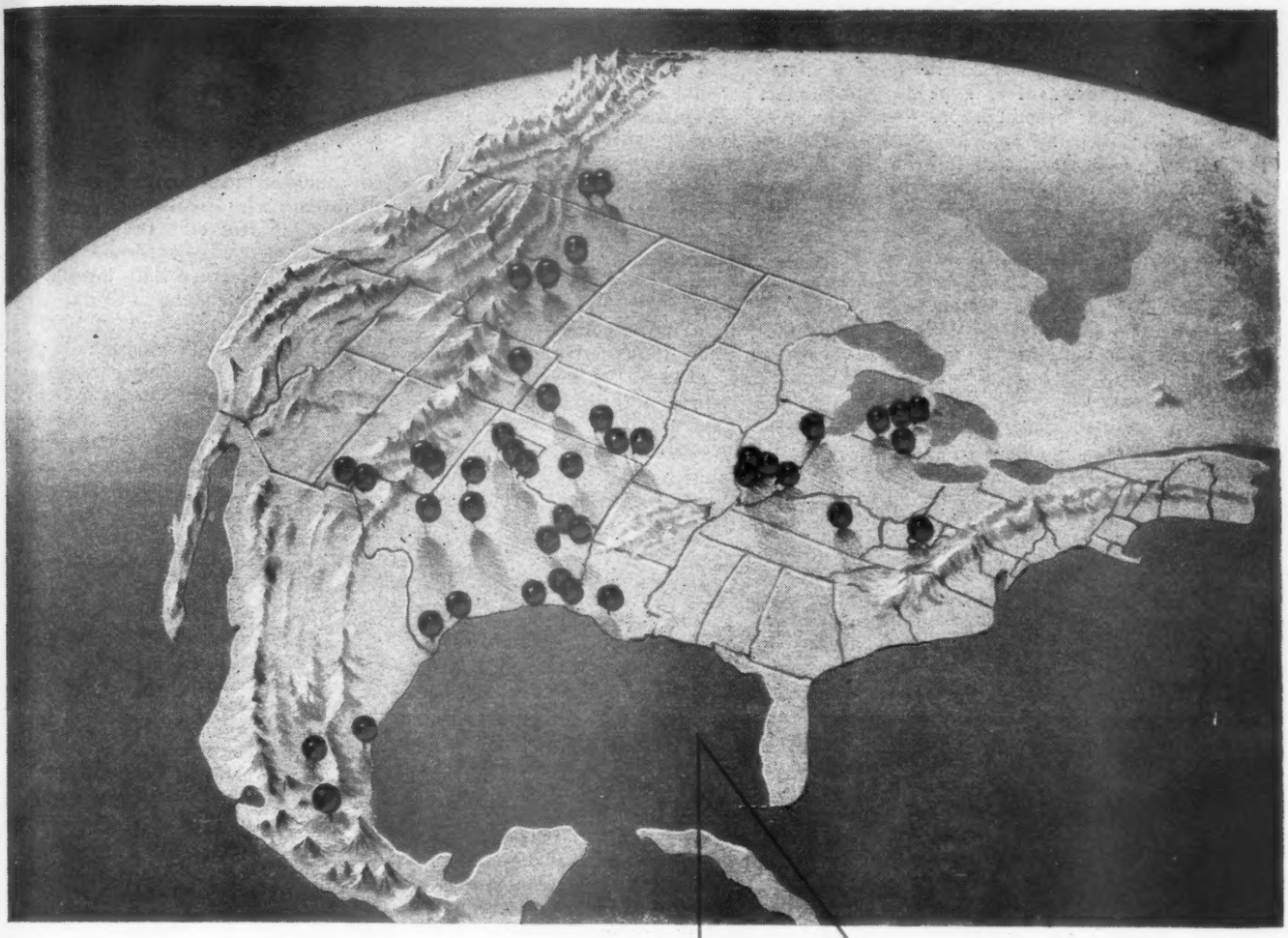
The selection of the materials for use in the pilot plant has been based on the conditions encountered in hydrogenation processes. Such processes are characterized by high pressure, high temperature, and the presence of highly corrosive substances. To meet these conditions we have used stainless steel, Type 347 whenever possible. This 18-8 columbium stabilized stainless steel has the high strength required for the design of vessels under high temperature and high pressure, the columbium stabilization gives protection against corrosion due to carbon precipitation in the critical range of 850 F to 1550 F, and the weldability of this steel makes it possible to attain flexibility in the fabrication of the unit. Until recently this steel has been readily available from warehouse stock in economical sizes and shapes so that costs have been reasonable.

Thus the reactors, condensers, and piping that are exposed to the materials being processed, have generally been made of Type 347 stainless steel and where built-up sections are permitted and in the piping generally all connections are made with Type 347 welding rod. Although a straight 18-8 stainless steel could be used in that part of the setup where the temperatures do not get into the critical range, 850 F and above, for resistance to intergranular corrosion, it has appeared practical and

FIG. 9. Pitting and intercrystalline corrosion at surface scratch type No. 347 stainless steel.

FIG. 8. Reactor cap—Type No. 322 SS.





CYCLOVERSION*

IN NORTH AMERICA

44 Perco* Cycloversion units with a total design capacity of 154,000 barrels per day are now operating or under construction

Are you interested in upgrading your refinery through-put at low cost? Write for full information on Perco Processes

PHILLIPS PETROLEUM COMPANY

PERCO DIVISION—Bartlesville, Oklahoma

*** A SERVICE MARK**

To obtain more information on products advertised see page E-51

desirable to use only the one material to avoid confusion.

In the light of present day conditions as far as the procurement of Type 347 stainless steel, it has become imperative that the practice of using Type 347 steel be re-examined. It is immediately obvious that all parts of the setup with the exception of the reactors and preheaters could be made of other corrosion resistant material without any change or danger to the operating procedure. Therefore, it is the reactors and preheaters alone that must be studied to determine what material can be used as a substitute for the hitherto successful Type 347 stainless.

There are two conditions that are encountered in the reactor and preheater that must be considered. First, the temperature range may reach 1000 F and second, some of the reactors are welded assemblies. Where the temperature range exceeds 850 F a straight 18-8 stainless has been avoided because of previous experience of intergranular corrosion in reactors made of this material. The use of Type 321 stainless-titanium stabilized has been successful where the vessel is made from a solid bar or forging and where welding has not been necessary. To a limited degree two additional stainless steels have been used, Type 316, 16 CR 10 Ni with 2 per cent molybdenum added, and Type 310, 24 CR 19 Ni. To the extent that these two steels have been tried we cannot definitely give an opinion as to their suitability because our experience is very limited. The availability of these steels from warehouse stocks is limited and in Type 310 we were not able to get tubing or pipe.

M. E. Holmberg[1] has suggested the possibility of using a stabilizing heat treatment to finished assemblies of non-stabilized grades of stainless to obtain satisfactory service at temperatures in the critical range of 850 F and above. This heat treatment designated as a spheroidizing heat treatment, consists of heating to 1525-1650 F, for a time long enough to precipitate the carbides along the grain boundaries and for diffusion to spheroidize the carbides so that they will not form a continuous chain. In addition, the time at temperature is sufficient to permit diffusion of the chromium and its replacement in the chromium depleted zone along the grain boundaries. We have not as yet used this method but this offers a workable substitute for the replacement of Type 347 stainless steel with non-stabilized and more readily available stainless steel.

The corrosion due to sulfur compounds when hydrogenating petroleum stocks can be very serious. In cyclic operation and regeneration, hydrogen sulfide and moisture are present during processing, and sulfur dioxide and sulfur trioxide and moisture are present during regeneration. Both of these mixtures are very corrosive at elevated temperatures. Inconel and high nickel alloys are not suitable for high temperatures in the presence of sulfur. Very few high chrome steels have been tested.

Attack due to sulfur is greatest at points where the metal surface has been scratched. A photograph showing pitting and intercrystalline corrosion that began at a scratch is shown in Fig. 9.

Heavy scaling has been found after several days operation in Type 310, Type 304, and Type 347 seamless drawn tubing under reducing conditions in the temperature range of 850-975 F at pressures of 250 psi to 800 psi. Upon cooling the tubing and exposing to air, the scale cracks off over a period of several hours. This effect is not noticed in operations lasting several hours. The analysis of the scale shows it to be essentially the same as the original metal.

A particularly vexing problem is the galling of threads in making the closure seal on reactors subjected to high pressures and high temperatures. Although great care is taken when assembling the parts to assure cleanliness of surfaces and coatings of various types are used, the loss of time and materials due to galled threads remains. The use of two stainless steels of different hardness in other types of work has offered a method of overcoming this problem. This method consists of using a Type 304 or Type 347 steel against a Type 322 precipitation hardening steel. It has worked with some degree of success.

In applying this method of dissimilar steels, as far as hardness is concerned, to process reactors there was a risk due to differential expansion. The Type 347 stainless is an austenitic steel with a coefficient of thermal expansion of 10.6×10^{-6}, the Type 322 stainless is a ferritic steel with a coefficient of thermal expansion of 6.5×10^{-6}. The Type 347 stainless is a non-hardening steel which has a hardness of 180 Brinell, Type 322 stainless is a hardenable steel which can be hardened to approximately 460 Brinell maximum. By making the caps of the reactors of Type 322 stainless and hardening to 450 Brinell the problem of thread galling when used on reactors made of Type 347 stainless has been greatly reduced. The difference in the coefficient of thermal expansion makes it necessary to use extreme care because exceedingly high stresses can be developed by the differential expansion. We have had all caps manufactured with due provision for the elimination of all sharp corners and surface scratches which will act as stress raisers. In addition the bolts through which the initial gasket seal is made (see Fig. 7) are so made and positioned so that they will fail in compression before dangerous stresses will be applied to the cap. The bolts are considered expendable and are replaced frequently.

Recent information[3] on Type 322 stainless obtained from studies of materials for use in jet engines, indicates that conservative stress values in the design and extreme care in handling must be used with this material. Tests show that Type 322 improves in hardness and impact value when tested at 700 F, but that there is a loss in physical properties, especially impact values, when the steel is tested at room temperature after being held at 700 F for some time.

Inspection and Testing

A study of the literature did not give any revealing information on what could be expected from the pressure vessels as far as creep was concerned. There is little published creep data for stainless steels operating under bi-axial stress and in the pressure range of 5000 psi. The protection of personnel made it desirable that some program of inspection and testing be formulated that would give a physical record of the vessels in operation. To that end we have set up a program of taking physical measurements of great accuracy of the vessels, both in the diameter and in the length, immediately after they are fabricated. These measurements are taken at specifically designated points on the vessel; such points are placed so that they are protected during the life of the vessel and can give repetitive readings that show accurate comparisons from one reading to another. It is intended that at frequent intervals the vessels be measured and the reading recorded and compared. In this manner the creep rate for the individual vessel can be plotted so that the effective life of any vessel can be determined from actual use data.

This system of recording creep data for pressure vessels in the laboratory is comparatively new and as yet there is not enough accumulated data upon which to base predictions of vessel life.

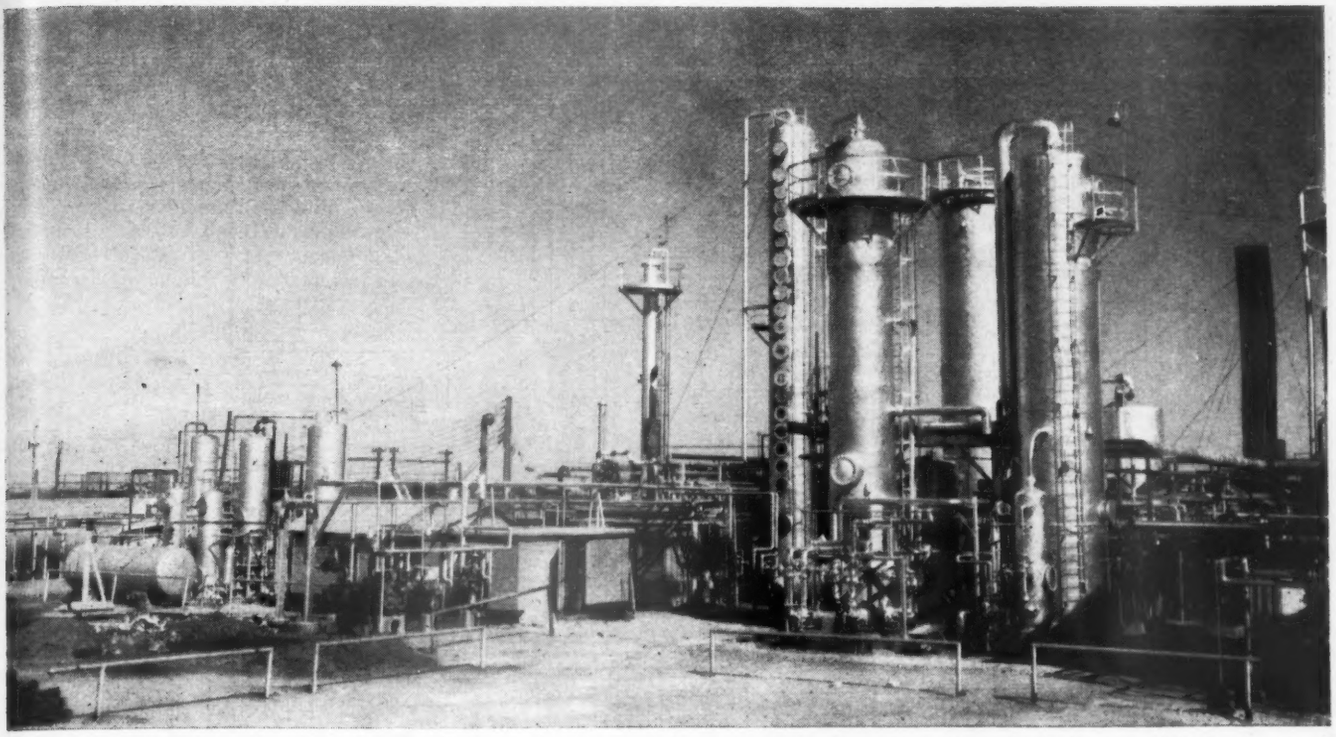
Summary

Bench-scale pilot plants are an important means of obtaining chemical and engineering design and operating data for development of full scale manufacturing units. The usefulness of a bench-scale pilot plant depends upon the safe design from the temperature and pressure standpoint as well as on the precision of instrumentation, the flexibility of the process design whereby changes in process may be made without major pilot plant design changes, and the ability of the pilot unit to perform in prototype the required functions of the full scale unit. Safe design for high temperatures and pressures depends not only on following existing pressure vessel codes but on using good engineering judgment in the selection of materials and the stress limits to which these materials may be subjected.

Bibliography

1. M. E. Holmberg, "Experience with Austentic Steels in High-Temperature Service in Petroleum Industry," Paper No. 50-A-41 A.S.M.E. Annual Meeting, New York, New York, November, 1950.
2. G. A. Nelson, "Metals for High-Pressure Hydrogenation Plants," Paper No. 50-SA-3, Petroleum Division A.S.M.E. Semi-Annual Meeting, St. Louis, Missouri, June, 1950.
3. J. F. Erthal, "Navy Studies Jet Structural Alloys at Intermediate Temperatures," *Iron Age*, May 10, 1951.
4. Jacobson, Wedner, and Beckwith, "The Design of Pressure Vessels for High Temperature, High Pressure Reactor Service," *Transactions*, A.S.M.E. Petroleum Mechanical Engineering Conference, Tulsa, Oklahoma, November, 1946.

★ ★ ★



View of main vessels and units in the plant, except the furnaces; foreground, Linde treater unit and salt drums; middle background, steam condensate drum, straight-run Linde reactor, and cracked naphtha Linde reactor; background, 12-in. debutanizer stabilizer, absorber, straight-run gasoline tower, debutanizer, desalter, cracked vapor separator and low-level drum, crude flash tower and stack of topper unit, and pressure distillate vapor line (vertical), extreme right.

60 Per Cent More Refining Capacity

Flow rearrangement, addition of poly plant, more heating coils and exchangers boosts crude capacity from 3200 to 5200 bbl a day

ARCH L. FOSTER*

ADDITION of more capacity to an already existing refinery is one of the most important ways by which a plant's output is augmented during the post-war readjustment period. Adding more capacity is done in numerous ways. One of the most effective methods is the relief of "bottlenecks" at different points in the plant's flow and in that case it appears that every plant built has one or more bottlenecks, which are controlling factors ruling the refinery's throughput.

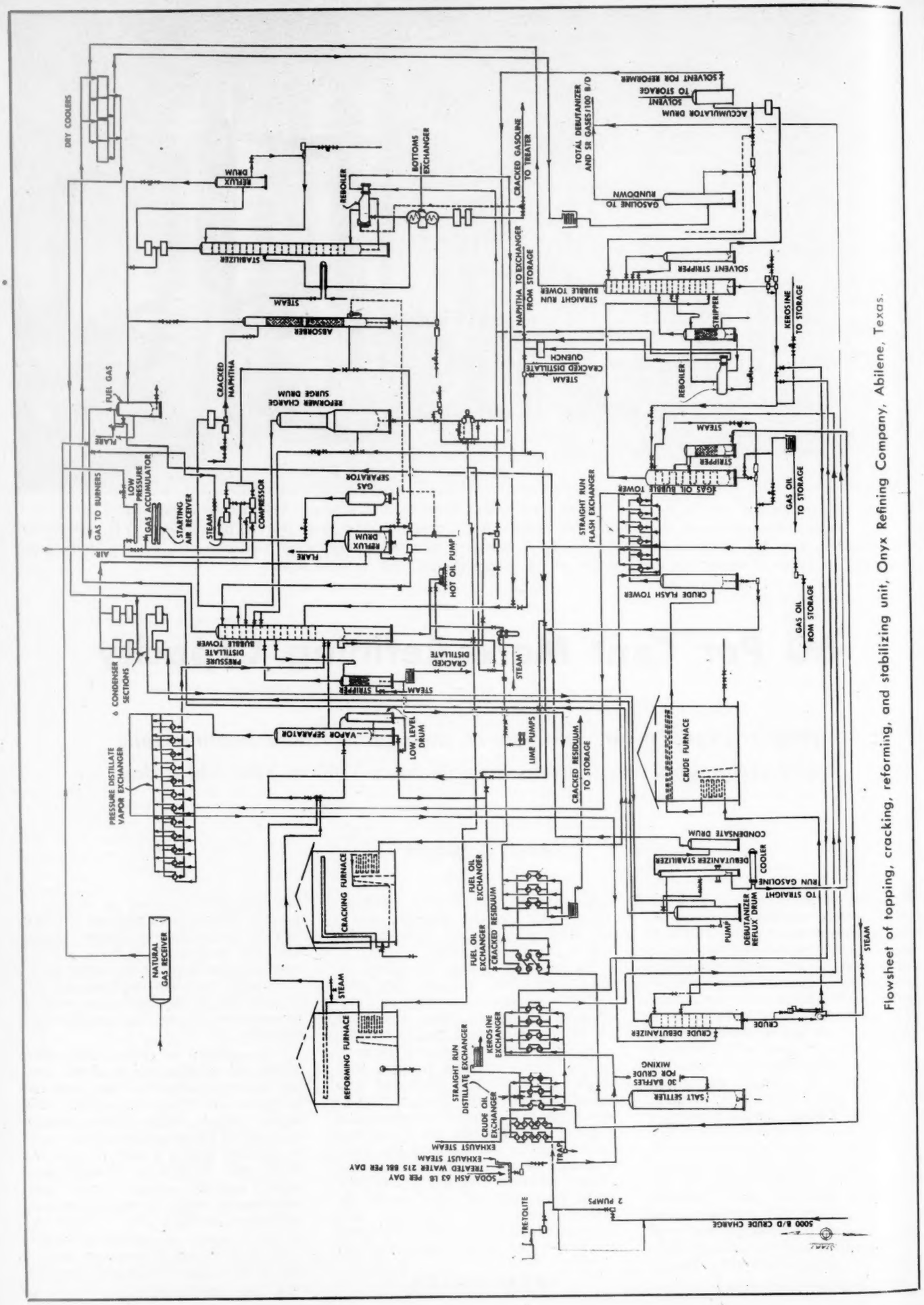
It is the case with the Onyx Refining Company's Hawley, Texas, refinery, a few miles north of Abilene, Texas, that these bottlenecks have been removed, with rather startling and very interesting results. As operated during the second World War this refinery included among its primary units a crude topping unit (furnace and tower), a heavy oil cracking unit, a naphtha reformer, fractionators to operate with these various units, a light oil—gasoline—stabilizer along with treating facilities, and a somewhat extensive heat exchanger system in the different steps.

To revise this system throughout, relieve "congestion", and save light gases formerly discharged to fuel gas, this company, under the direct supervision of Mixson Kincannon, superintendent, is adding: Non-selective catalytic polymerizer unit; cracking furnace, with single row floor tubes; additional compressor capacity and charge pumps; new pressure distillate fractionator, and a 6-tray extension onto the straightrun fractionator by welding atop the latter a section of the old PD fractionator. Other additions include: Low-level drum, connected with the base of the cracking unit vapor separator; new pressure distillate absorber; four Marley dry cooler units; transfer of old cracking unit absorber to service as polymer debutanizer; addition of 6 new sections to distillate exchanger assembly; two exchangers in S. R. distillation bank, and kerosine exchanger bank. Eventually a catalytic cracking unit will be installed to aid further in meeting competition in motor fuel qualities and quantities.

In addition to these items, some 30,000 bbl of plant and rundown storage has been added, and the plans are to replace all bolted storage tanks with welded storage. Further plans include some 40,000 bbl of additional storage to be installed within a year or two. Included with all this are change-locker house, material storage, repair and maintenance shops to expand present inadequate facilities. Much of this expansion program was instigated by the splitting of a receiver drum and the resultant fire that destroyed a control room some months ago.

*Editor, Refining and Gas Processing.

EXCLUSIVE



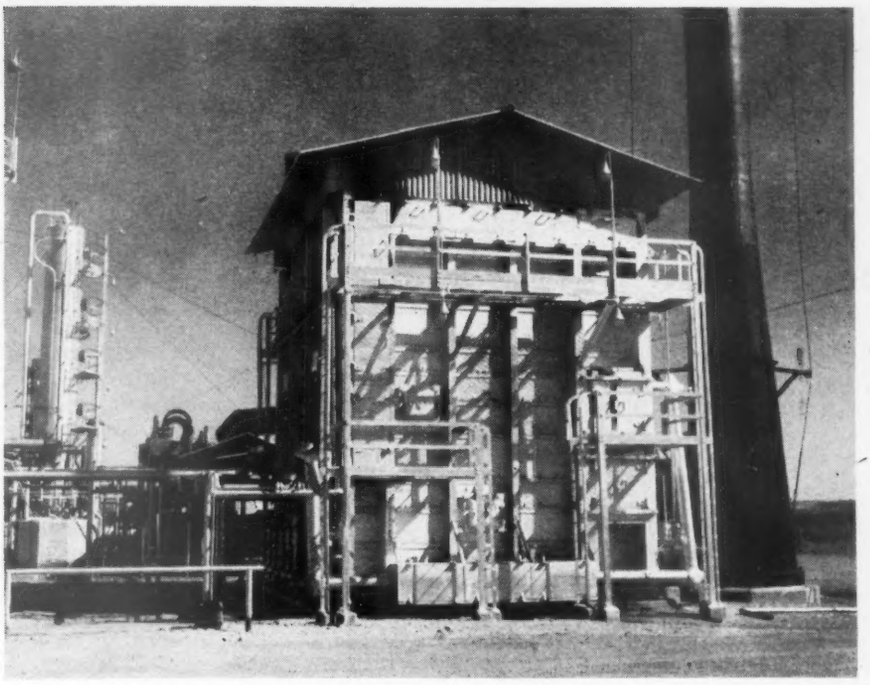
Flowsheet of topping, cracking, reforming, and stabilizing unit, Onyx Refining Company, Abilene, Texas.

Operation of the Plant

This refinery operates on sweet Central Texas crudes. As of three years ago the plant's maximum capacity was 3200 bbl per day of crude charge. By the installation of the additions mentioned above and to be mentioned later herein, that capacity has been boosted to a maximum of 5200 bbl per day and may be increased to 5500 bbl per day by other contemplated or planned changes.

The crude charge is pumped from storage, a small amount of Tretolite solution plus a solution of sodium carbonate containing 0.5 lb of Na_2CO_3 per barrel of charge are added and the crude is preheated by exchange with surplus exhaust steam. The steam carbonate solution is made up with soda ash, treated water, and exhaust (condensed) steam to the proper concentration. Next the crude exchanges with straight-run distillate from the side stream stripper of the gas oil fractionator, followed by exchange with the kerosine stream, four pairs of exchangers in parallel. This preheated, treated crude, at a normal temperature of about 220 F is then passed to a 30-ft section of baffled 6-in. pipe, for mixing crude and solutions thoroughly before entering the salt settler, a 7-ft by 42½-ft tower, from which the settled-out salt and water are removed at the bottom. Desalted crude is transferred to exchange with residual fuel oil from the low level drum of the cracking unit vapor separator, on to exchange further with the overhead vapors from the crude flash tower in six parallel exchangers. Finally the crude exchanges with pressure distillate vapors in six parallel exchangers, to which six other sections were added recently, in parallel with the existing six units. From this exchange, at a temperature of about 460 F the crude goes to the crude debutanizer, from the bottom of which "stabilized" crude is pumped to the crude furnace via the secondary crude pump. It passes through the conventional convection section of tubes, and through roof tubes banks from which two rows are to be removed, leaving 73 tubes of 3¼-in. id. At some 710 F temperature the crude is flashed in its small tower, 6-ft by 20-ft. The overhead vapors pass off to exchange with desalted crude as mentioned earlier and enter above the first tray into the gas oil bubble tower at about 635 F. This gas oil tower has 10 trays on 2-ft spacing, and is 5-ft diameter by 26-ft high. The reduced crude from the bottom of this crude flash tower go to the outlets of the cracking and reforming furnaces as quench oil, whence it is transferred to the vapor separator. A stream from the side draw of the crude debutanizer enters the gas oil tower just below the regular reflux of bottoms from the straightrun tower.

From the gas oil fractionator, into the bottom of which steam is admitted as stripper medium, the overhead vapors go directly to the straightrun fractionator just above the first of the 19 trays in that tower.



In the background of this view of the W-K furnace are the boilers, reformer, new cracking furnace, pressure distillate bubble tower and stripper, and the vapor separator.

Overhead from this straightrun tower is transferred directly to two sections of the Marley "dry" cooler unit, where the stream goes in at about 250 F and out at 185 F, returns to cooler coils in the water cooler or "coil shed" with water spray over the coils, and to a reflux drum and rundown line to storage.

From the fourth tray of the gas oil tower a side stream is drawn, stripped with steam in a stripper tower packed with 10-ft of Raschig ceramic rings. Vapors from this return to the gas oil tower two trays above the offtake; the stripped bottoms pass in heat exchange with incoming crude in the second exchange stage following the steam preheat stage, and to a cooler coil and storage as straightrun distillate. This stream is made normally to 180-200 flash point. Immediately below the regular inlet for reflux to the gas oil tower, regular reflux for which is a stream of kerosine from the bottom of the straightrun tower, a side stream from the crude debutanizer is introduced as mentioned above, serving as part of the reflux of the gas oil tower. The main service of sending this stream into the tower, however, is to bypass the crude furnace; thereby the total throughput is raised by about 250 bbl of crude per day, one item in the overall boost of the crude throughput by opening another bottleneck.

Bottoms from the gas oil tower are sent directly to the third tray of the pressure distillate (PD) tower; any excess gas oil bottoms is bypassed to storage as finished product or to be picked up later by the charge pump if and when needed. As noted above the kerosine and lighter overhead vapors from the gas oil tower go directly to the straightrun tower and enter the flash section below the bubble trays and just above the stripper tray.

The method of revamping and of improving the fractionation of this straightrun tower, is of interest. The old PD tower was found to be well corroded in its lower section and has been replaced. An upper 20-ft section—6 trays—of the old tower was cut off; a two-foot section was fitted with small pins and welded to the top of the old SR tower from which the head had been removed. The main section was slipped over these pins and the two sections welded together, making the present much more efficient tower, its improvement coming from the use of an old tower portion, without additional cost except labor. The main reason for this extension was to permit withdrawal of a low octane rating naphtha fraction for reforming.

From the bottom of the straightrun tower a kerosine stream is steam stripped. All of the kerosine, both reflux and kerosine to storage, go through exchangers and is then split, all not used for reflux on gas oil tower goes to storage.

The next side cut from the fractionator is drawn from the seventh and/or eighth trays. This is a stoddard solvent fraction meeting the Texas Stoddard specifications. This is stripped in a 2 by 18 ft tower with 10 ft being packed with Raschig rings and using a reboiler with strapping steam to maintain a flash specification of 114 F. Normally, this steam amounts to 7½ per cent of crude charge.

The next cut from the fourteenth and/or fifteenth tray practically meets VM&P specifications. All this material not needed for JP-3 base stock is re-

formed. The total being about 9000 gal per day. Ammonia is used in this tower's vapor line to prevent condenser corrosion.

Top vapors from the crude debutanizer pass to condenser sections and to the debutanizer reflux drum. From this drum top vapors go to a 12-in. diameter debutanizer stabilizer with a welded-in cross-drum type of reboiler, all operated at about 35 psig. Uncondensed gas from this tower top passes to the plant fuel gas system; bottoms are cooled by water then join atmospheric tower straightrun gasoline stream and go to treating for storage.

All gasoline components, straightrun and cracked as well, go to a caustic wash before passing to the rundown tank.

Cracking and Reforming

As mentioned above, gas oil that is cracker charge is sent from the gas oil tower bottom to the pressure distillate (PD) fractionator. From the bottom of this tower the bottoms, including raw charge and recycle, go at about 650 F and 48-50 psig to an 8-stage, horizontal Byron-Jackson electric-driven charge pump, at the rate of 4300 bbl of total charge per day, entering the cracker furnace at 700-710 psig and exiting at about 400 psig. The new W-K furnace with single row floor tubes was built to accomplish two desired results. One, to increase cracking that was needed to take care of increased crude throughput; two, to make olefins for the Cat Poly. The original furnace had forty-seven 3-in. ID tubes in the convection section and eighty-seven 3-in. ID tubes in the radiant and soaking sections of the roof. This required too high furnace temperatures; a new section of 14 tubes was added in the floor; 12 of these are in 6 pairs of parallel flow tubes.

All convection tubes are 4-in. OD, 4-6 per cent chrome, ½ per cent molybdenum as are the roof tubes. Of the floor tubes the first and last, which carry the entire stream, are 4½-in. OD, (3½-in. ID), for greater capacity and less pressure drop. The other 12 are 3-in. ID. The regular flow in the furnace is into the convection section, into the floor section or coil, and then the charge passes through one tube, originally in the wall's non-radiant section. From there it goes into the radiant wall tubes, through the radiant roof tubes, to upper roof tubes, and back to wall tubes, and out to pressure release quench point.

This furnace has been and will be running at 935 F outlet temperature, until the polymerizer unit is on stream sometime this autumn, due mainly to limited compressor capacity. When the poly plant is operating the temperature will be boosted to about 950 F. Lime is added to the cracking charge just beyond the recycle flow meter for corrosion prevention.

Reduced crude is injected into the cracker furnace transfer line, as mentioned earlier, reducing the charge temperature to about 815 F. The bottom of the vapor separator has only a liquid seal, and recently has been connected with a low-level drum that receives the liquid residuum. By holding a level in this drum no liquid is held in the separator at all, merely sealed by the liquid seal, a level control instrument handling the proper level in the drum. Cracked residuum from this drum shows about 350 SF viscosity, exchanges heat with incoming desalted crude, is cut with cracked distillate to hold 290-300 viscosity, then goes through a cooler to storage.

The overhead line from the vapor separator has been increased in size from 8-in to 10-in. These vapors pass to 12 exchanger units meeting incoming crude; 6 of these exchangers have been added recently to assist in cooling the vapors from around 810 F to 650 F after which they go to the P. D. tower flash section just below the first bubble tray. On the 8th tray from the bottom cracked distillate is withdrawn, the major portion of which goes direct to the reformer charge surge drum, the smaller amount being stripped with steam in a Raschig-ring packed tower 24-in. by 19-ft, and passing to storage. This cracked distillate is normally about 530 endpoint material, some being sold—that which has been stripped—as No. 2 furnace oil with 150 F flash specification. A portion may even be added to the reduced crude, as quench oil. The reformer surge drum (accumulator) has a vent line connecting its top with the PD column.

Typical operations charge 670 bbl of this accumulated cracked distillate along with 217 bbl of the solvent stream to the reformer convection section, having 2-in. OD tubes of 4-6 chrome, ½ moly and welded return bends instead of tube headers. This furnace is cleaned out by burning out its coils instead of cleaning them by older, mechanical methods; plans are to use the same system on the cracking unit coils, simplifying and reducing the cost in labor and time for cleanups on these coils as well. From the convection coils the reformer charge goes to the radiant coils in the roof then into the roof soaker coil and out to the quench point at 650 psig and 1005 F. Quenched with the same reduced crude and cracked distillate that is used on the cracked stream, the two mingle and enter the pressure distillate column as indicated earlier above.

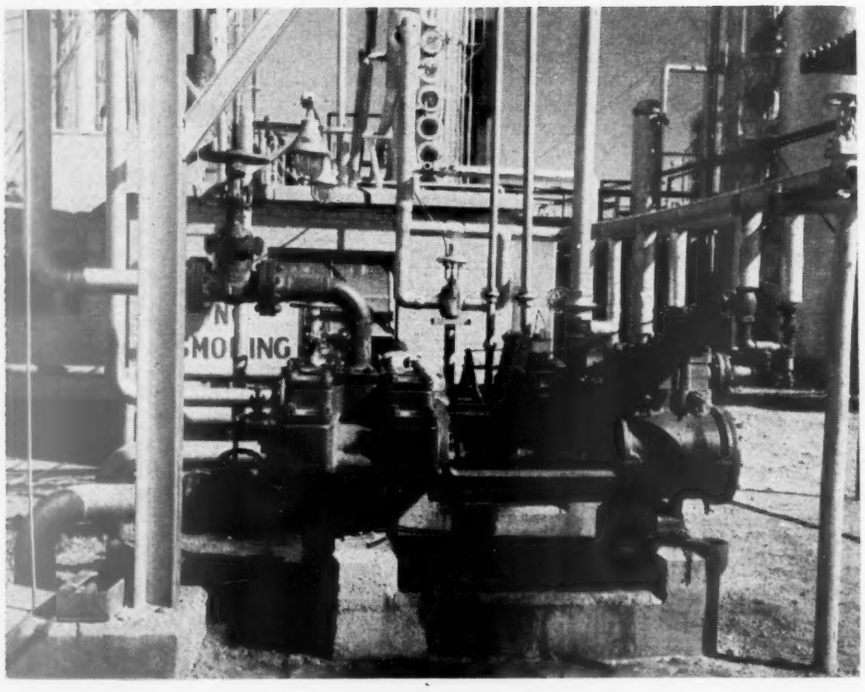
From the third tray from the top of the PD column a stream of somewhat more than 400 bbl per day of 425 F endpoint distillate is drawn as absorber oil, goes through a cooler and into the present absorber column to meet vapors and gases from the PD gas separator drum and liquid from the PD reflux drum. This absorber is Raschig-ring packed, is 24-in. diameter and 42½-ft high, operated at 80 psig. This absorber will be converted soon to the stabilizer for the polymer gasoline product.

Rich oil from the absorber is sent to exchange with bottoms from the main plant stabilizer, with steam in a section of G-Fin preheater exchangers, and into the stabilizer on the 12th tray from the bottom. From the reboiler the stabilized bottoms exchanges with incoming raw distillate and goes out to the treater unit. Overhead light gases are cooled, caught in the reflux drum, and the excess goes to the plant fuel gas system.

Overhead from the pressure distillate tower goes to the second half of the "dry coolers", through four condenser sections in the spray tower, and to the PD reflux drum, having been cooled from 340 F to about 200 F in the dri-cooler*

*Marley.

Newly installed Worthington primary crude charge pump, to handle increased throughput.



A CLEAN SWEEP

ANOTHER WAY OF SAYING UOP SERVICE IS COMPLETE

Even the charwoman reminds us — UOP Service makes a *clean sweep* through every phase of process development and plant operation . . . and continues on "after hours," after the refinery is on stream.

It's a service *complete* in every detail, including laboratory research, pilot plant work, economic evaluations, engineering, construction supervision, licensee instruction, and equipment inspection. In addition, UOP field men — familiar with refinery operations all over the world — are available, on request, to aid in maintaining day-to-day operating efficiency.

As a comprehensive form of protection, UOP Service helps avoid losses due to interruptions in your planned program of operation.

UNIVERSAL OIL PRODUCTS COMPANY

UOP®

General Offices: 310 S. MICHIGAN AVE., CHICAGO 4, ILL., U.S.A.
Laboratories: RIVERSIDE, ILLINOIS

Universal Service Protects Your Refinery

To obtain more information on products advertised see page E-51

and 95 F in spray tower. PD reflux is drawn from this drum, the main body of the pressure distillate going to the absorber as mentioned and on to the stabilizer for final reduction to initial boiling point, vapor pressure, etc. From this PD reflux drum the overhead gas goes to a 16 by 20 and a 13 by 20 Clark Compressor, and to the absorber as noted earlier. Incidentally, the stabilizer has 20 trays on 18-in. spacing, is 24-in. diameter by 38-ft high, and equipped with an outside steam reboiler.

The new polymerization unit under construction will include a Girbotol unit to remove hydrogen sulfide from the gas charge; the original crude is "sweet", having about 0.25 per cent sulfur, while the residuum has about 0.75 per cent sulfur. Gases from the PD separator will be picked up by the first stage of Cooper-Bessemer compressors, then to a water cooler and a liquid trap, that is, an interstage condensate drum. They will then combine with stabilizer gas to the Girbotol and the caustic wash treaters, and into the second stage of the compressors, coming out at 530 psig to the polymerizer reactor at the rate of 1,820,000 cu ft per day, passing through a lubricating oil knockout drum before reaching the reactor. Condensed steam is added to all three reactor beds by three small pumps to aid catalyst activity, and the cleaned, moistened gas enters the reactors at about 500 psig. After passing through the catalyst beds the polymerized product goes to a catalyst fines remover, to the condenser and polymer separator. Gases from this separator go to a new absorber, which will be 18-in. diameter by 20 ft high, containing 12 ft of 5/8-in. Raschig rings. These stripped gases will go back to the now existing line from the cracking unit absorber discussed above. The new absorber may use either part of the solvent naphtha cut or cracked 440 F endpoint naphtha as absorption oil. This fat oil will go to one side of the reformer charge pump; the other side will handle 440 E. P. cracked naphtha from the accumulator drum. Liquid from the bottom of the polymer separator passes to the depropanizer, from the top of which the stripped gas goes to the refinery fuel gas collector. Depropanized bottoms is used as quench for the polymerizer reactor and as a reflux for the depropanizer. Polymer reboiler bottoms pass to the polymer debutanizer, the present cracking plant absorber. The overhead gas from the debutanizer goes to refinery fuel, the bottoms being finished stabilized polymer gasoline. The oil being used at present as reboiler heating oil will be used on the depropanizer reboiler, which will operate at 325 psig.

An interesting advantage shows up when studying the operating results of the plant. When, earlier, it was operating on 4300 bbl per day maximum crude charge the refinery produced 48 per cent of gasoline along with 23½ per cent of residual fuel oil. At its present rate of 5000-5200 bbl per day 52 per cent of gasoline and only 20 per cent of the low-priced fuel oil are made. This improvement is attributed to the increase in cracker recycle rate, from 2160 bbl per day to 4300 bbl, and to enlarging the topping furnace outlet from 4 in. OD to 6⅝ in. OD. This cut pressure drop and increased the amount flashed from the crude. Thus the total gasoline production is increased from less than 2100 bbl per day to more than 2700 bbl per day, while making essentially the same amount, 1000 bbl per day, of fuel oil. * * *

Accounting to Producers for Residue Gas*

RALPH A. WORLEY†

Purpose: To enable producers to understand how residue gas was accounted for under qualitative and quantitative method.

Forms for "Statement of Casinghead Gas Purchases" and "Statement of Residue Gas Returned to Lease."

Something over a year ago, when we started charging for excess residue gas returned to producers, a survey was made to ascertain what information was being supplied the producers and we found confusion compounded. The determination of and accounting for residue gas under the "Q & Q" method, now existent in practically all gas contracts, is of itself a very complicated procedure for the plant operator, and evidently when the plant operator had figured it out, he thought the producer should understand what he had done and our survey showed no clear statement of what transpired was being furnished to any producer. There seemed to be as many different statements furnished the producer as there were different plant operators. The greatest failing was that plant operators were using the same statement for debit, or credit, to the producer. To say the producers' accountants were confused, is putting it mildly.

We devised two statements: One, to cover credits for gas sold off lease, which is incorporated with regular gas purchase statement; two, to cover excess residue used on lease, which is also an invoice. It will be noted that each statement spells out precisely how to calculate the residue gas. Also, the producer has to pay State of Texas tax on value of residue gas (remaining from original wet gas) that is returned to lease. The producers were entirely in the dark on this. We point out on both statements exactly what he should report to the comptroller. This method of accounting for residue gas has met with unanimous approval of the producers connected to our plant. * * *

THIS IS AN INVOICE
PLEASE REMIT

THE PARADE COMPANY
SHREVEPORT, LOUISIANA

Statement of Residue Gas Returned to Lease

MONTH _____ 19__

OPERATOR _____ LEASE _____

G. P. M. _____ (1) THEORETICAL PERCENT RETURNABLE _____ (2) VALUE PER M. C. F ON EXCESS GAS RETURNED TO LEASE _____

(5) M. C. F. TO P'MT	(6) THEORETICAL M. C. F. RETURNABLE TO LEASE (3 X 1)	(9) PERCENT FACTOR OF AMOUNT RETURNABLE TO LEASE	(4) ACTUAL VOLUME M. C. F. RETURNABLE TO LEASE (6 X 9)	(7) M. C. F. RETURNED TO LEASE	(8) EXCESS VOLUME M. C. F. RETURNED TO LEASE (Subtract)	AMOUNT DUE THE PARADE COMPANY (8 X 2)

THE PARADE COMPANY
SHREVEPORT, LOUISIANA

Statement of Casinghead Gas Purchased

OPERATOR _____ MONTH _____

ADDRESS _____

LEASE _____ RUSK COUNTY, TEXAS. No. OF WELLS _____

(1) M Cu. Ft.	X Gal. Per M Cu. Ft.	= GALLONS	X Royalty Per Cent	= Net Gallons	X Price Per Gal.	= 26/70 Amount	AMOUNTS Rel. & Pro.	AMOUNTS Residue Gas	Total Amount	Tax	Net Amount

RESIDUE GAS CALCULATION (If No Figures Shown Below — See Invoice Attached)

(2) Theoretical Percent Returnable To Lease Based on G. P. M.	(3) Theoretical M. C. F. Returnable To Lease (1x2)	(4) Percent Factor of Amount Returnable To Lease	(5) Actual Volume M. C. F. Returnable To Lease (3x4)	(6) M. C. F. Residue Returned To Lease	(7) Excess M. C. F. Residue Sold off Lease (5—6)	(8) 50% Value Residue Sold off Lease Per M. C. F.	(9) Value of Residue Sold off Lease (7x8)

REPORT TO THE COMPTROLLER AT AUSTIN, TEXAS, AS RESIDUE GAS RETURNED TO LEASE ONLY THE AMOUNT SHOWN IN COLUMN 6 TAX HAS BEEN PAID ON EXCESS.

*NGAA First Prize Winner—Class D.
†Assistant general manager, The Parade Company, Shreveport, Louisiana.

MATHIESON'S AT YOUR SERVICE... at LAKE CHARLES, La.

Mathieson service starts at the plant with top quality chemicals... produced in the ever-increasing quantities demanded by American industry... shipped when and where needed. From Lake Charles, Louisiana, for example –in the heart of the thriving Gulf Coast region–Mathieson delivers by ship, train and truck on reliable schedules, these heavy chemicals:

Soda Ash **Caustic Soda**
Ammonia **Nitric Acid**
Nitrate of Soda

Mathieson's at your service from 16 strategically situated plants. Supplementing this efficient distribution system is a network of jobber and distributor stocks for less-carload deliveries.

You may find it to your advantage to discuss with us now your future chemical requirements. Mathieson Chemical Corporation, Baltimore 3, Maryland.

MATHIESON
HEAVY CHEMICALS

Sulphuric Acid • Processed Sulphur • Soda Ash
Caustic Soda • Bicarbonate of Soda • Ammonia
Sodium Chlorite • Nitrate of Soda • Chlorine
Calcium Hypochlorite

Mathieson
CHEMICALS

9297

SERVING INDUSTRY, AGRICULTURE AND PUBLIC HEALTH

P 739.3

Gas Plants for Catalytic Cracking Units

Methods are presented here for application of new principles to higher propane and butane recoveries

FORREST E. GILMORE* and ROBERT D. BAUER*

In recovering the light olefins from catalytic cracking unit gases, a slightly greater amount of saturated light hydrocarbons is also recovered. Over one-half of these are usually isobutane that can usually be used in alkylating the olefins. The remaining normal butane can be included usually in motor fuel. This leaves the propane for use as fuel when other fuel prices are high or for sale as LPG when its price justifies. In the past LPG prices have varied greatly it being completely unmarketable at times, especially in the summer months. The recent rapidly expanding market for its use as motor fuel, fairly well developed for use in farm tractors and now being developed in buses and fleet motor vehicles, indicates the growth of a more stable and higher priced market. In the Society of Automotive Engineers symposium of last January in Detroit, the use of LP gas as tractor and automobile fuel was discussed in three papers dealing with supply, distribution, adaptation, and operation. The growth in customer demand is illustrated by the number of LP gas conversion units of farm tractors made in the past three years, which were 25,300 in 1948; 37,200 in 1949, and it is estimated they exceeded 100,000 in 1950.

Refinery gas extraction plants are usually of two general process types: Compression and oil absorption. Practically all of the recent plants have been of the absorption type, which has great advantages over the compression type when high propane-propylene extraction is desired. Other extraction processes that could be used include adsorption on activated charcoal and direct fractionation of the gas. The adsorption on activated charcoal appears to be suitable only for removing the last traces of propane-propylene from the residue gas of inefficient extraction units. Direct fractionation with refrigerated overhead condenser could in all probability be worked out satisfactorily process-wise and might be competitive with oil absorption for extremely high extraction efficiencies. The oil absorption plant is pretty definitely the most advantageous method of recovering between 70 and 90 per cent of the propane-propylene in the gases from a catalytic cracking unit. Oil absorption plants can obtain a high recovery of propane in almost any range of operating temperatures and pressures. Low temperatures through refrigeration may be used in lieu of higher pressure or absorption oil rate.

The four principal factors contributing to high extraction in an absorber are: Increase in pressure, increase in the molal ratio of absorption oil to gas, lower temperature of absorption and increased number of equilibrium stages, i.e., theoretical trays. Another factor in the overall propane recovery efficiency of the gas plant is the absorption of undesirable light fractions such as ethane and methane, which usually must be removed from the gas plant products and in the removal carry propane and propylene along with them. These gases can be recirculated through the absorber thereby adding to its gas load and requiring more absorption oil, a higher absorption pressure or lower absorption temperature for the higher extraction necessary to obtain a net overall propane extraction efficiency, which in turn increases the extraction of undesirable light gases until a large and expensive recycle builds up. To avoid this to some extent it is now becoming customary to add a rich oil deethanizing section to the absorber below the feed the rich oil being heated with a reboiler.

Method of Obtaining High Propane-Propylene Recovery

While there are many variations of the highly complex oil-absorption plants the basic methods of computing the effect of various factors are well established and are briefly outlined in the following. The recovery hydrocarbons from a gas in an absorber is a function of the absorption factor A defined by the following equation:

$$A = \frac{L}{KV}$$

where,

A = absorption factor
L = mols per unit time of downflow oil
V = mols per unit time of upflow vapors
K = equilibrium constant of the component under consideration

Increasing the absorption factor, A, at a given set of operating conditions and fixed number of equilibrium steps, increases the absorption of the chosen component. An analysis of the terms in the absorption factor equation leads to the following methods of increasing the extraction of gas components in the absorber: (1) increase the molal oil rate by increasing the oil volume rate or by using a lighter absorption oil; (2) decrease the molal vapor rate by decreasing gas feed rate as a result of condensing more of it by means of greater cooling with or without commingling in the condenser with gasoline or by decreasing the recycling of ethane and lighter gases, previously absorbed, to the absorber; and (3) decrease the equilibrium constant "K" by absorbing at lower temperatures or higher pressures.

These three methods by which the absorption factor, A, can be increased are now considered in more detail.

Absorption Oil Rate. In designing a new oil absorption plant the absorption oil rate required for a specified extraction does not present the problems usually encountered in revamping an existing unit for higher propane recovery. In a new plant the absorber and subsequent towers and their auxiliary equipment may be sized to handle the required oil rates, while increasing the oil rate in an existing unit to increase propane recovery may entail considerable changes in the mechanical design of existing equipment. If the existing absorber is operating at its liquid handling capacity, the effective oil rate can frequently be increased by altering the tray details and downcomers, using a lighter absorption oil thus obtaining more mols of downflow oil per barrel of liquid handling capacity or by both increase in the liquid handling capacity of the trays and the use of lighter absorption oil.

Debutanized gasoline and more recently unstabilized gasoline from the main condenser of the synthetic crude tower of the catalytic cracking unit are principal absorption oils used in recently designed catalytic cracking unit gas recovery plants. As an example of the advantage of using a light absorption oil in a TCC unit gas plant operating at 225 psig it would require 60 per cent more barrels of the old-fashioned 200 molecular weight absorption oil than unstabilized catalytic gasoline or 20 per cent more barrels of heavy catalytic gasoline than unstabilized catalytic gasoline to accomplish an 85 per cent

*Phillips Petroleum Company, Bartlesville, Oklahoma.

May your Christmas be happy
and the New Year prosperous

THE LUMMUS COMPANY

385 MADISON AVENUE, NEW YORK 17, N. Y.

HOUSTON • CHICAGO • LONDON • PARIS • CARACAS

DESIGNING ENGINEERS AND CONSTRUCTORS FOR THE PETROLEUM AND CHEMICAL INDUSTRIES

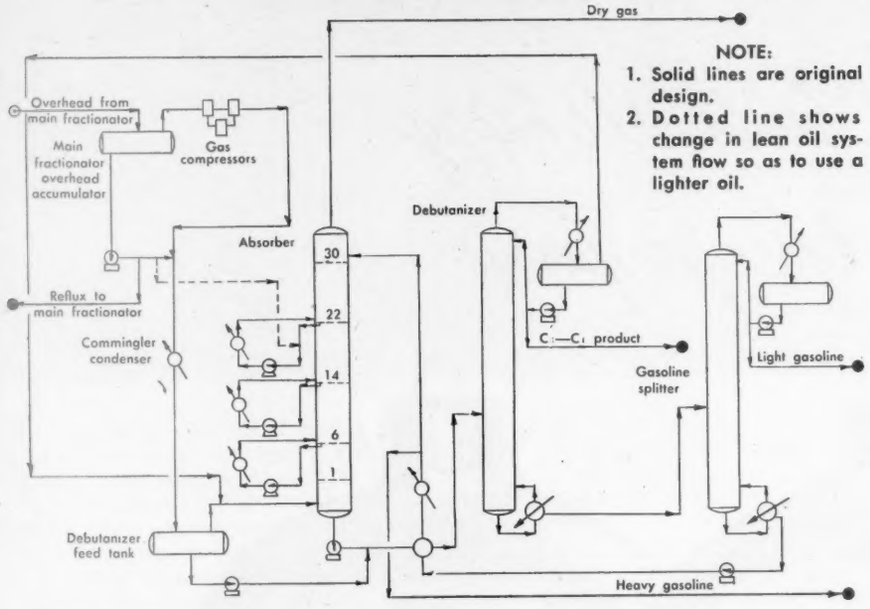


FIG. 1. Catalytic cracking unit gas plant for moderate propane recovery.

propane-propylene recovery. The big advantage in using unstabilized catalytic gasoline over debutanized catalytic gasoline is that it completely eliminates the recycle stream of lean oil and thus to a large extent unloads the subsequent fractionating equipment.

Fig. 1 shows a flow diagram of a gas plant designed to recover about 60 per cent of the available propane from a catalytic cracking unit. The lean oil was a heavy catalytic gasoline of 350-430 F boiling range. It operated satisfactorily at the designed recovery efficiency and a decision was made to increase the propane-propylene recovery to the maximum amount that could be obtained by increasing the lean oil rate. With this original arrangement and capacity of the fractionation equipment the lean oil rate was found to be limited not by the liquid handling capacity of the absorber but by the capacity of the debutanizer reboiler so that an increase in the lean oil circulation of only about 10 per cent was obtained. The piping change shown by the dotted line was made without shutting down the unit. This change permitted the use of unstabilized catalytic gasoline as lean oil with a stream of heavy catalytic gasoline over the top tray as sponge oil.

Typical residue gas analyses and oil rates for these two types of operation are shown in Table 1. Column A shows the previous operation using heavy catalytic gasoline as lean oil and Column B shows the operation after the change was made. This table shows that the residue gas analyses of these operations are comparable as are also the total oil rates to the absorber. This indicates that, under the same total lean oil rate to the absorber, the recovery is about the same, however, by the change, the total fractionator reboiler steam load was reduced 40 per cent. In the change the eight top trays of the absorber were taken over as a sponge oil section with only 50 bbl per hour over its trays. This means that residue gas B was actually obtained with fewer trays than residue gas A thus showing by actual operating data the advantage of using light absorption oil. Calculations made on the changed type of operation with 200 bbl per hour of unstabilized catalytic gasoline as lean oil and 200 bbl per hour of heavy catalytic gasoline as sponge oil showed an increase in propane extraction to about 80 per cent and that the load on the subsequent fractionation equipment would be considerably less than it was under the original 60 per cent propane recovery operation.

Column C of Table 1 shows why it is important to have an adequate sponge oil section when using light absorption oil. As the gas leaving the top of the absorber is at its dew point and attains this condition by equilibrium contact with the sponge oil, it is evident that a heavy sponge oil is advantageous as it will not only recover the components stripped out of the light lean oil by the gas but also will allow very little of itself to pass out in the residue gas. Catalytic gas oils, which can readily be obtained from and returned to the main fractionator of the catalytic cracking unit, are excellent sponge oils, however, if they are used it is best to have the sponge oil section as a separate small absorber rather than as the top section of the main absorber in order to eliminate any possibility of contaminating the gasoline yield with the gas oil through a faulty trap-out or leaky tray.

The principal advantages in using light absorption oil, in addition to increased absorption per barrel used, consist of unloading of reboilers and coolers, reduction in pumping costs, and compared with absorption oils heavier than gasoline the elimination of the lean oil still including expensive heat exchangers, heaters, condensers, and lean oil coolers.

Gas Feed Rate. Careful consideration should be given to lowering the volume of rich feed to the absorber by operating at the highest pressure consistent with the plant's ability and cooling the rich gas as nearly as practical to cooling water temperature thus condensing as much as possible of it. It is probable that refrigeration of the catalytic cracking unit main condenser gas in commingling relation with the condenser liquid to between 40 and 50 F is justified because it will not only reduce the gas feed to the absorber but will also greatly decrease the gas volume to the gas compressors as well as increase the volume of unstabilized catalytic gasoline available as absorption oil. Commingling of the compressed gases from a catalytic cracking unit with the unstabilized catalytic gasoline in a condenser will reduce the absorber feed gas volume. A more advantageous use of the unstabilized catalytic gasoline, however, is to be had by using it for lean oil.

Catalyst Poisoning Increases Gas

To those familiar with catalytic cracking, the residue gas compositions shown in Table 1 indicate the unit is suffering from metallic poisoning of the catalyst. Metals in the gas oil feed deposit on the catalyst converting part of it into a dehydrogenation catalyst resulting in the production of hydrogen and coke at the expense of gasoline yield. Thus it is apparent that one very desirable way of decreasing the gas volume charged to the catalytic cracking unit absorber consists in the elimination of this metallic poisoning of the cracking catalyst.

Another way of lowering the gas volume to the absorber, usually by about 5 to 7 per cent, is by better stripping of the regenerated catalyst so that the very minimum amount of inert gases are allowed to enter the reactor and pass on into the gas recovery system.

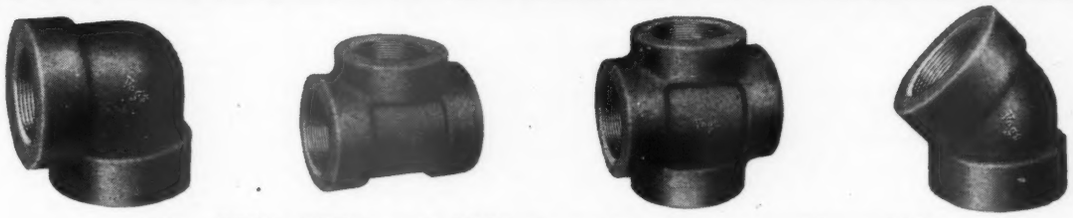
The elimination or lowering of any recycle gases to the absorber will result in more efficient recovery. For this reason it is advisable to operate the frac-

Table 1. Effect on absorption of molecular weight of lean oil (from operating tests).

Component	Residue gas mol % A		B		C
CO	1.0		1.5		1.3
CO_2	1.4		1.7		1.3
N_2	12.4		8.1		7.6
O_2	0.7		0.6		0.5
H_2	48.2		52.4		53.9
H_2S	1.2		1.5		1.3
C_1	17.7		15.4		15.9
C_3=	2.5		4.4		3.1
C_3	7.4		6.8		5.4
C_3=	3.9	7.5	4.1	7.6	2.8
C_3	2.9		2.5		1.9
C_4+	0.7		1.0		5.0
	100.0		100.0		100.0
Lean oil					
Bbl/hr	280		225		250
Molecular weight	155		117		117
°API @ 60°	36.9		54.2		54.2
Sponge oil					
Bbl/hr	0		50		0
Molecular weight			155		
°API @ 60°			36.9		
Pressure, psig	140		140		140
Total fractionator reboiler, steam required, lb/hr	41,800		25,400		

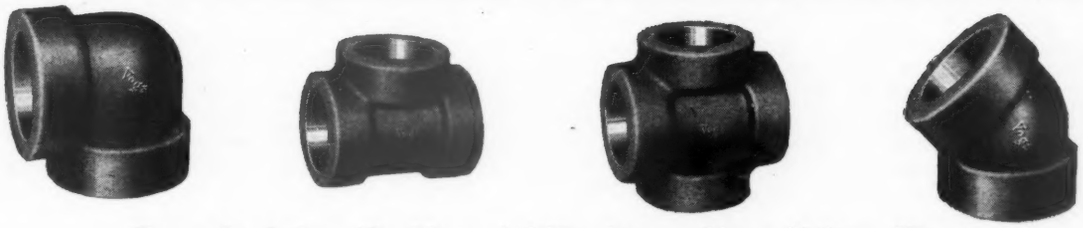
STRENGTH

for Safety and Long-Time Service



For 2000, 3000 and 6000 pounds service — Sizes 1/8" to 6"

SCREW END TYPE



For schedules 40, 80 and 160 pipe — Sizes 1/8" to 4"

SOCKET WELD TYPE

Vogt Ells, Tees, Crosses, etc., are forged from carbon steel or various alloys to meet specific operating conditions. Catalog F-9 will aid you in their selection and proper application.

Shocks and stresses imposed by high pressures and high temperatures are taken in their stride because Vogt fittings are uniform in structure, fine grained, and free from porosity . . . the superior product of laboratory controlled materials and giant forging hammers and upsetters. These properties also give higher resistance to erosive and corrosive conditions, thereby adding to service life expectancy in steam plants, petroleum refineries, chemical plants and related industries.

Vogt — FOR BETTER FITTINGS

HENRY VOGT MACHINE CO., INC.
Louisville 10, Kentucky
BRANCH OFFICES: NEW YORK • PHILADELPHIA • CLEVELAND • CHICAGO • DALLAS

Vogt DROP FORGED STEEL FITTINGS

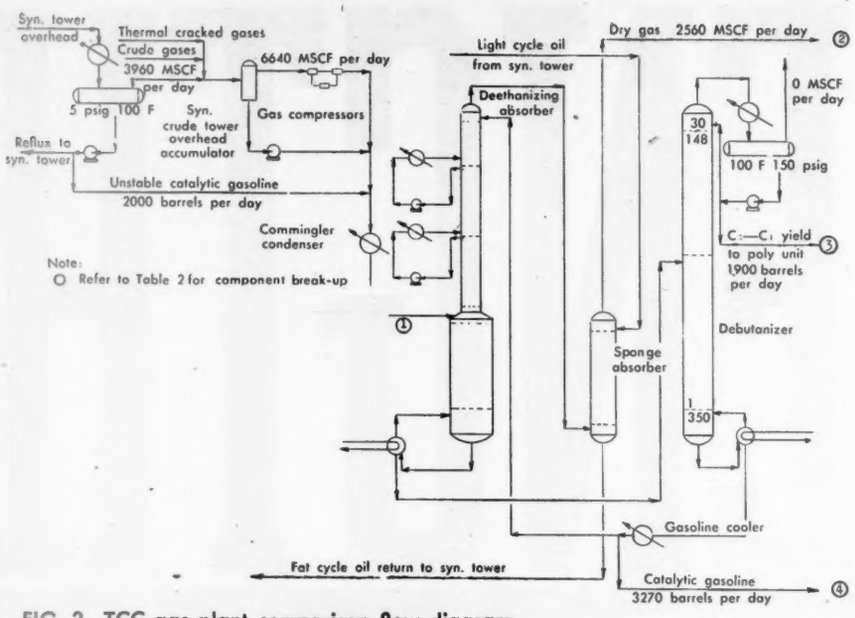

Syn. tower overhead
Thermal cracked gases
Crude gases
3960 MSCF per day
6640 MSCF per day
5 psig 100 F
Syn. crude tower overhead accumulator
Gas compressors
Reflux to syn. tower
Unstable catalytic gasoline 2000 barrels per day
Commingler condenser
Note:
O Refer to Table 2 for component break-up
Light cycle oil from syn. tower
Dry gas 2560 MSCF per day
Deethanizing absorber
0 MSCF per day
100 F 150 psig
C3—C4 yield to poly unit 1900 barrels per day
Debutanizer
Sponge absorber
Gasoline cooler
Fat cycle oil return to syn. tower
Catalytic gasoline 3270 barrels per day

FIG. 2. TCC gas plant comparison flow diagram.

tionation equipment following the absorber at the highest pressure and with the lowest temperature possible on the overhead condenser of the column and thus hold the recycle gas volume at a minimum.

Pressure and Temperature. The absorption formula shows that the absorption factor of each component of the gas varies inversely as the equilibrium constant and as increased pressure or decreased temperature decrease the equilibrium constant they will also increase the extraction efficiency of the absorber. The equilibrium constants of the various components of the gas are not equally affected by changes in pressures and temperatures, those of the heavier hydrocarbons being affected relatively more by temperature changes and those of the lighter hydrocarbons being affected relatively more by changes in pressure. This means that a lowering of the absorption temperature would favor butane absorption, but have little effect on ethane absorption and going to high pressures so greatly favors methane and ethane absorption that the elimination of these undesirable gases from the final products may become a serious problem.

In order to show the effect of various customary absorption pressures, process designs were made of gas plants to process the combined gases from a TCC unit, a thermal cracking unit and a crude unit at absorption pressures of 60, 150, and 225 psig. The following premises were used for each of these calculations:

(1) Recover 85 per cent of the available propane-propylene, and

(2) Use an absorber with a fractionating section below the gas feed entrance to deethanize the rich oil sufficiently that the LPG propane from the depropanizer of a catalytic polymerization unit, utilizing the debutanizer overhead liquid stream, would need no further deethanization.

The overall material balance for each gas plant design is the same, regardless of the operating pressure, and is shown on a molal basis in Table 2. Fig. 2 shows the process flow used for the plants and Table 3 the results of the calculations and the design data. It will be noted from these data that as the operating

Table 2. Material balance data for TCC gas plant comparison.

Component	(1) Total* charge M/H	(2) Residue gas M/H	(3) Poly feed M/H	(4) Gasoline yield M/H
Inerts	4.2	4.2	—	
H_2S	6.1	5.5	0.6	
H_2	91.7	91.7	—	
C_1	82.9	82.9	—	
C_2	59.6	56.7	2.9	
$C_2=$	18.6	18.4	0.2	
C_3	84.2	8.2	76.0	
$C_3=$	75.0	13.2	61.8	
C_4	92.1	—	90.1	2.0
$C_4=$	72.9	—	71.4	1.5
C_5	119.6	—	3.1	116.5
C_6-350° EP	227.5	—	—	227.5
	934.4	280.8	306.1	347.5
MSCF/D		2560		
Bbl/SD			1900	3270

* Combined gases from TCC unit, thermal unit, and crude unit plus all synthetic crude tower overhead liquid.

Table 3. TCC gas plant comparison at various operating pressures.

Operating pressure, psig	60	150	225
Propylene-propane recovery	85	85	85
Gas to compressors, MSCF/D	6,640	6,640	6,640
Compressor BHP requirement	550	940	1,125
Commingler condenser duty, M Btu/hr	4,130	5,550	6,000
Deethanizing absorber data			
Top section diameter	6′-0″	3′-6″	3′-0″
Bottom section diameter	7′-0″	5′-0″	5′-0″
Rich gas feed, MSCF/D	4,340	3,330	2,540
Lean gas, MSCF/D	2,560	2,560	2,560
Gasoline lost to lean gas, B/D	43	23	20
Lean oil, B/D	12,910	3,700	3,380
Light cycle oil to sponge absorber, B/D	1,680	820	720
Gallons of lean oil/MSCF of total gas	87	31	25
Rich oil bottoms, B/D	18,080	8,870	8,550
Theoretical absorption trays	10	10	10
Average absorption temp., °F	100	100	100
Theoretical stripping trays	10	10	10
Average stripping temp., °F	160	165	200
Reboiler temperature, °F	200	235	270
Intercooler duty, M Btu/hr	3,200	1,780	1,900
Reboiler duty, M Btu/hr	11,830	9,400	10,300
Per cent vaporization of total feed	50	35	30
Debutanizer data			
Tower diameter	7′-0″	5′-0″	5′-0″
Feed, B/D	18,080	8,870	8,550
Overhead—liquid, B/D	1,900	1,900	1,900
—vapor, MSCF/D	0	0	0
Bottom yield, B/D	3,270	3,270	3,270
Bottoms lean oil recycle, B/D	12,910	3,700	3,380
Overhead condenser duty, M Btu/hr	8,900	8,900	8,900
Reboiler duty, M Btu/hr	22,870	12,300	10,400
Utilities			
Steam—75 psig, lb/hr	—	9,900	11,500
—250 psig, lb/hr	27,900	15,000	12,700
Electric power, KWH	118	19	30
Cooling requirements, M Btu/hr	29,100	26,800	26,900
Estimated operating cost,* $/D	374	321	332

* Does not include labor.

FIG. 3. Pressure vs. compressor BHP.

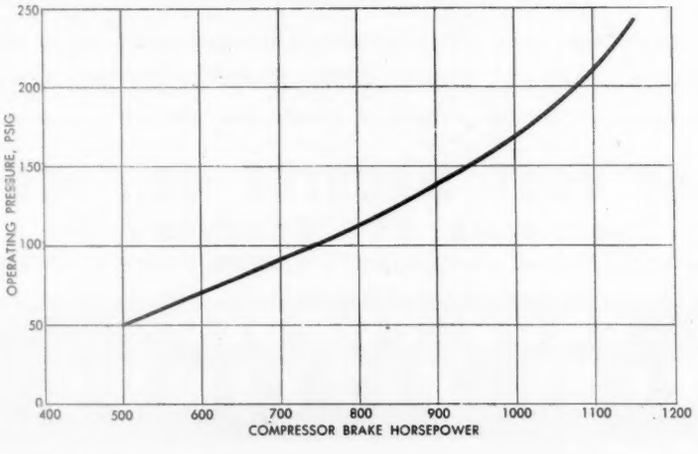
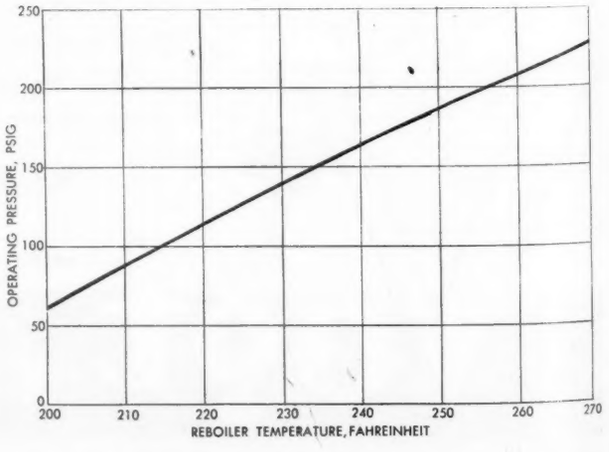


FIG. 4. Pressure vs. reboiler temperature in TCC deethanizing absorber.



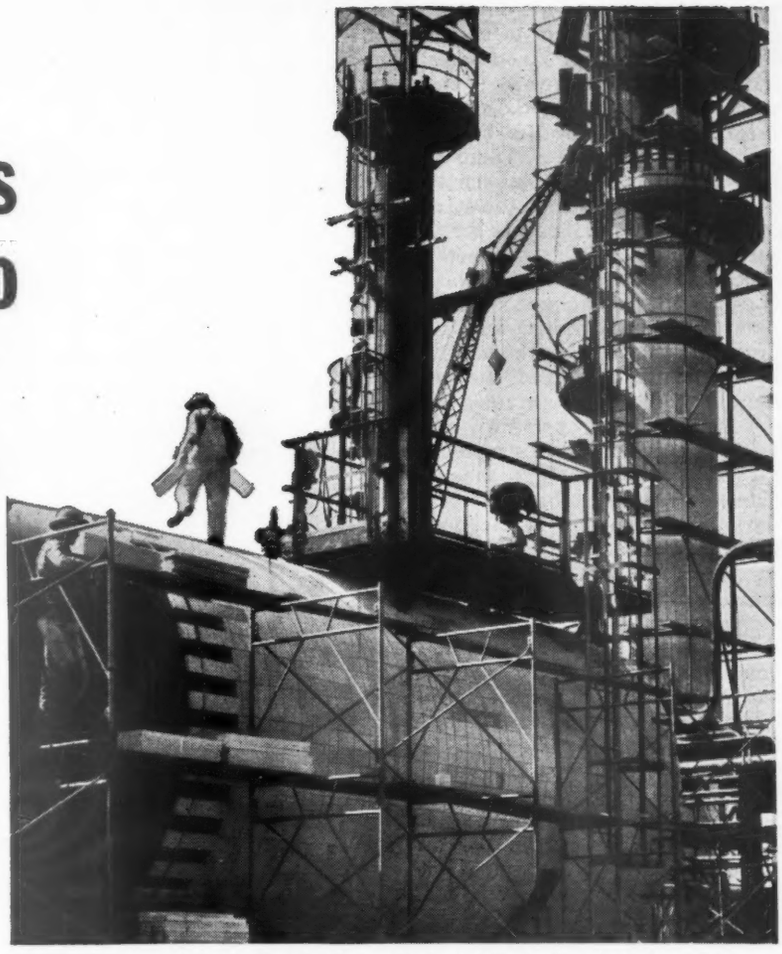
6 Reasons Why

Leading Refiners Are Switching to KAYLO HEAT INSULATION

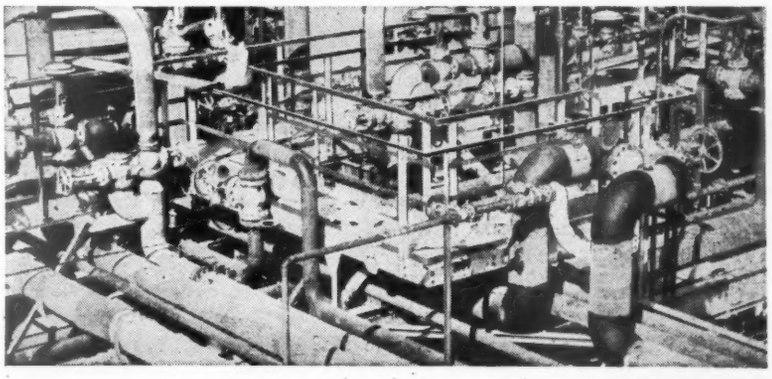
Through demonstrated superiority, Kaylo Heat Insulation is rapidly becoming recognized as the first basic advancement in the high temperature field in many years. Compare these advantages:

- Kaylo Heat Insulation is a calcium silicate (not glass)—an inorganic material which retains its stability in long service under severe conditions;
- Kaylo Heat Insulation has a wide effective temperature range—up to 1200°F.—eliminating need for combination covering in nearly all operating conditions;
- Kaylo Heat Insulation is insoluble in water. Work is not delayed by wet materials;
- High strength of Kaylo Heat Insulation practically eliminates spoilage both in transit and in application. Workmen can walk on insulated equipment without breaking insulation;
- Light weight along with high strength of Kaylo Heat Insulation makes application easier and faster;
- Simplified Dimensional Standards of Kaylo Pipe Insulation permit use of double layers for the higher temperatures without the use of special materials.

It will pay you to investigate the advantages offered by Kaylo Heat Insulation.



Applications of Kaylo Heat Insulating Block and Kaylo Pipe Insulation, The Texas Company Refinery, Lawrenceville, Illinois. M. W. Kellogg Company, New York, Designer and Builder. New construction includes units for fluid catalytic cracking, fractionation, gas recovery and catalytic polymerization.



SEE OUR CATALOG IN SWEET'S FILE PROCESS INDUSTRIES

For complete details on Kaylo Heat Insulation, write Dept. N-177, Owens-Illinois Glass Company, Kaylo Division, Toledo 1, Ohio.

KAYLO® ... *first in calcium silicate*

...*pioneered by* OWENS ILLINOIS Glass Company

MAIN OFFICE: TOLEDO 1, OHIO—KAYLO SALES OFFICES: ATLANTA • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND DETROIT • HOUSTON • MINNEAPOLIS • NEW YORK • OKLAHOMA CITY • PHILADELPHIA • PITTSBURGH • ST. LOUIS • WASHINGTON

pressure is increased the differences between the plants begin to narrow. For example, differences in oil rates, heat duties, operating expenses, etc., are much greater between the 60 and 150 psig cases than they are between the 150 and 225 psig cases. There appears to be little difference between the 150 and 225 psig cases from the standpoint of equipment requirements for the absorber and debutanizer. One notable exception to this is the compressor brake horsepower requirement, which continues to increase fairly rapidly as the pressure is increased. The absorber reboiler temperature and the average stripping section temperature also increase with the operating pressure. These trends are shown graphically on Figs. 3, 4, and 5. In Fig. 6, the required diameter of the absorption section is shown as a function of the operating pressure and indicates that, under the conditions chosen for this problem, increasing the pressure decreases the diameter but at a diminishing rate.

In determining the size of the columns for this comparison, the liquid and vapor loading were calculated, the latter at 100 per cent of the value given by the Brown and Souders mass velocity equation and the tower sized for whichever load was the greater. The debutanizer and the absorption section of the absorber were sized for vapor loading while the stripping section of the absorber was sized largely for liquid loading, all bubble trays being of the conventional type. This method of column sizing was used in order to take advantage of any possible savings in steel. Other savings in steel could be obtained probably by using some of the special new types of trays their manufacturers claim would allow the tower diameters to be reduced.

Fig. 7 shows how the rich feed gas to the absorber may be decreased by compressing it to a higher pressure, and commingling it with the unstabilized catalytic gasoline while cooling to 100 F. This, however, is an expensive method of decreasing the gas volume to the absorber because in going from 150 to 225 psig the compressor horsepower is increased by 20 per cent while the gas volume decreases 15 per cent.

Fig. 8 shows the loss of gasoline to the residue gas as a function of the operating pressure and indicates that operating at 150 psig as compared to 60 psig will save about $80 per day in gasoline losses. There is little difference between the gasoline lost by operating at 150 and 225 psig.

Fig. 9 shows the lean oil required to obtain the 85 per cent propane-propylene extraction as a function of the total gas feed to the absorber and the operating pressure. This curve indicates that at pressures above 200 psig the lean oil requirement per MSCF of feed gas begins to level out. This behavior is also evident from the fact that the equilibrium constants of propane and heavier

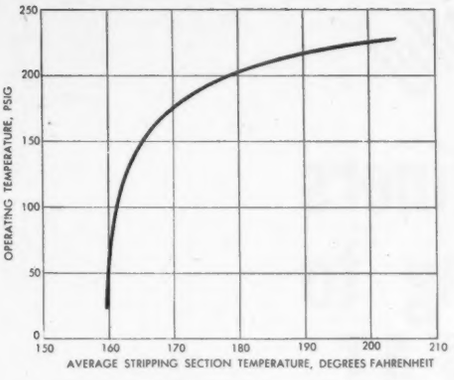


FIG. 5. Pressure vs. average stripping temperature in TCC deethanizing absorber.

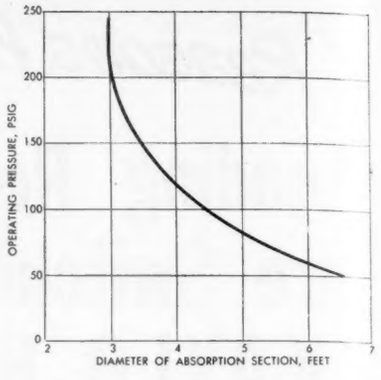


FIG. 6. Pressure vs. absorption section diameter in TCC deethanizing absorber.

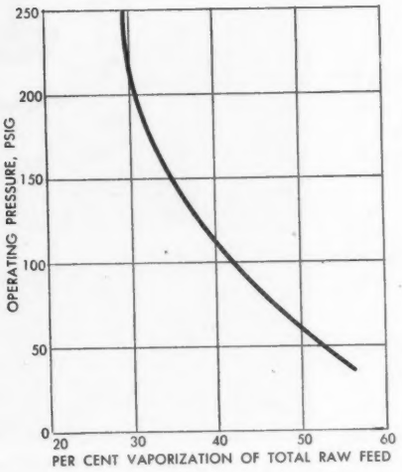


FIG. 7. Pressure vs. condensation of raw feed gas in TCC unit.

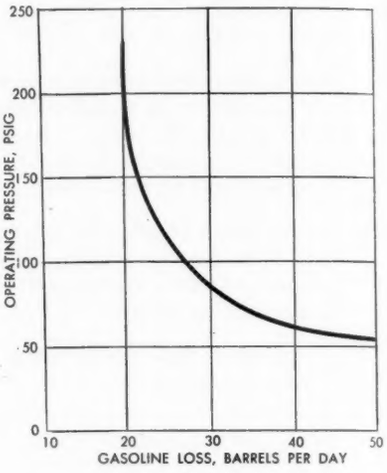


FIG. 8. Pressure vs. gasoline loss to dry gas from TCC deethanizing absorber.

FIG. 9. Pressure vs. lean oil rate in TCC deethanizing absorber.

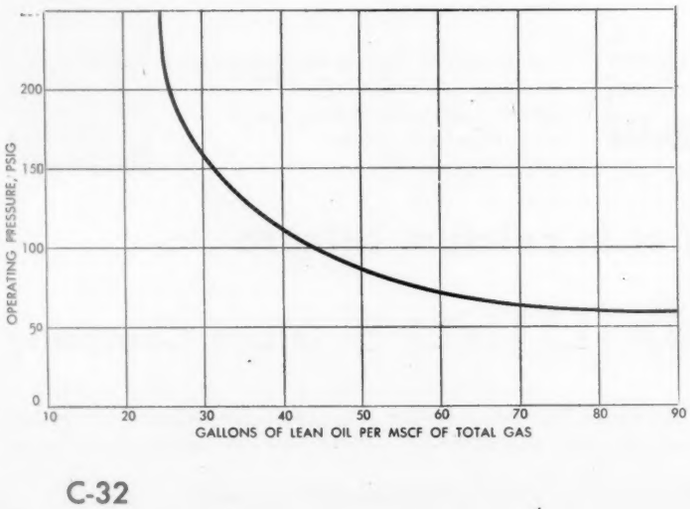


FIG. 10. Pressure vs. vapor rates in TCC deethanizing absorber.

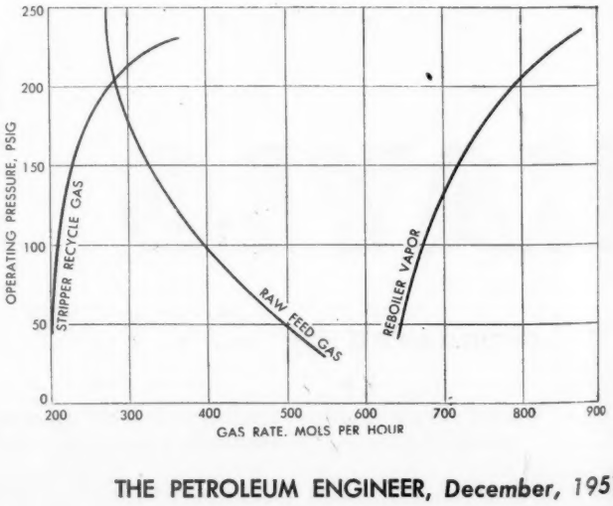


Table 4. TCC gas plant comparison, 150 psig—with and without refrigeration.

	No refrigeration	With refrigeration**
Propane-propylene recovery	84	85
Operating pressure, psig	150	150
Gas to compressors, MSCF/D	6,640	6,640
Refrigeration compressor, BHP	—	267
Gas compressor BHP requirement	940	940
Total compressor BHP	940	1,207
Commingler condenser duty, M Btu/hr	5,550	5,550
Deethanizing absorber data		
Top section diameter	3′-6″	3′-6″
Bottom section diameter	5′-0″	5′-0″
Rich gas feed, MSCF/D	3,330	3,330
Lean gas, MSCF/D	2,560	2,560
Gasoline lost to lean gas, B/D	23	Negl.
Lean oil, B/D	3,700	2,540
Light cycle oil to sponge absorber, B/D	820	820
Gallons lean oil/MSCF of total gas	31	21
Rich oil bottoms, B/D	8,870	7,710
Theoretical absorption trays	10	10
Average absorption temperature, °F	100	50
Theoretical stripping trays	10	10
Average stripping temperature, °F	165	165
Reboiler temperature, °F	235	235
Intercooler duty, M Btu/hr	1,780	910
Reboiler duty, M Btu/hr	9,400	5,000
Per cent vaporization of total feed	35	35
Debutanizer data		
Tower diameter	5′-0″	5′-0″
Feed, B/D	8,870	7,710
Overhead—liquid, B/D	1,900	1,900
—vapor, MSCF/D	0	0
Bottom yield, B/D	3,270	3,270
Bottoms lean oil recycle, B/D	3,700	2,540
Overhead condenser duty, M Btu/hr	8,900	8,900
Reboiler duty, M Btu/hr	12,300	11,500
Utilities		
Steam—75 psig, lb/hr	9,900	—
—250 psig, lb/hr	15,000	—
—340 psig, lb/hr	—	20,900
Electric power, KWH	19	15
Cooling requirements, M Btu/hr	26,800	21,500
Estimated operating cost,* $/D	321	250

* Does not include labor.
** Applied to lean oil and intercoolers only.

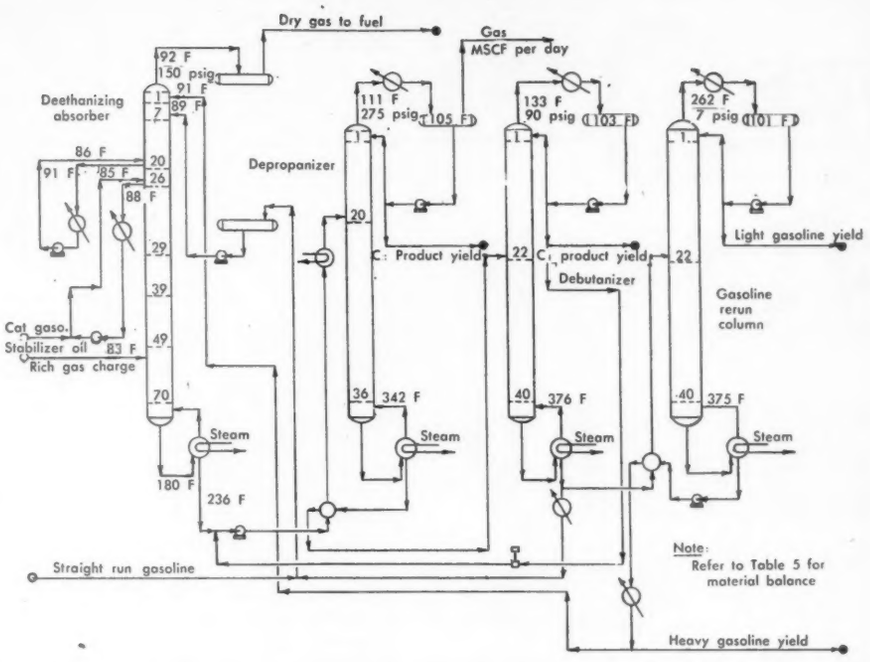


FIG. 11. Catalytic cracking unit gas plant with a deethanizing absorber.

are increasingly sensitive to temperature changes as the temperature decreases blow 150 F and decreasingly sensitive to pressure changes as the pressure increases, especially for pressures above 200 psig.

Fig. 10 shows the gas loads at various points in the deethanizing absorber. This figure shows that while operation at the higher pressure may decrease the feed gas to the absorber, it will make the stripping operation for deethanization more difficult consequently increasing the internal recycle vapors from the stripping section to almost the same extent the feed gas is decreased.

Based on the above, it appears that the 60 psig case when using temperatures obtained by the use of cooling tower water, cannot be economically employed to the best advantage thus narrowing the choice down to the 150 and 225 psig cases, neither one of which has any decided advantage over the other. The 150 psig case appears to be nearer the optimum point on the curves and should cost somewhat less to construct and operate.

Table 4 shows a comparison between the previously described 150 psig plant and a 150 psig plant using butane refrigeration for cooling the lean oil and the absorber intercoolers to obtain an average absorption temperature of 50 F. The material balance is the same as for previous cases. The greatest saving by using refrigeration is in the lean oil circulation, which was reduced to about 70 per cent of that required in the plant without refrigeration. Additional savings were obtained in reboiling steam and cooling water costs while gasoline losses to residue were reduced to practically none. The 265 bhp required for the refrigeration is a cost that is partially offset by savings in sizes of reboilers, condensers, coolers, and pumps. It seems that this application of refrigeration is justified by the saving in operating costs and reduction of gasoline losses to the residue gas. Although no detailed comparisons have yet been made, it may well be that the optimum pressure for 50 F absorption is much lower than the 150 psig used. Also, that applying refrigeration to the main fractionator overhead condenser of the catalytic cracking unit thus greatly reducing the gas to the compressor and to the absorber and in turn supplying more unstabilized catalytic gasoline for lean oil so that no debutanized gasoline need be recycled for lean oil would prove to be a more economical type of gas recovery plant.

Deethanizing Absorbers. In any efficient absorption type gas recovery plant the removal of ethane and lighter absorbed components without loss of propane and propylene is a major problem. In plants operating with high propane recovery and without deethanization of the rich oil, vapors from the subsequent fractionators must be reprocessed in either a reabsorber or returned to the main absorber in order to maintain the high recovery of propane. By proper operation of a rich oil deethanization scheme it is possible to operate the fractionators, such as depropanizers or debutanizers, with total condensation of their overhead products at ordinary plant temperatures and pressures and in this way eliminate costly and uneconomical flashing, recycling, recompression, and reabsorption operations.

In a recent article[2] the estimated cost of a gas plant using a novel rich oil stabilization scheme waste quoted to be 15 per cent less than the most economical design that could be otherwise arrived at. Generally, in catalytic cracking unit gas plants it is not necessary to yield an LPG stream as overhead from the depropanizer or debutanizer since the total overhead product from these fractionators is normally fed to some catalytic conversion process. If the feed stream to the conversion process is not deethanized, however, it will be necessary to deethanize the propane effluent from such conversion process if it is to be used as LPG. If the conversion process is an HF alkylation unit it will be imperative to have an almost completely deethanized feed for it. The elimination of ethane and lighter is also desirable in order to lower the pressure requirements on storage vessels and process equipment. The fractionating absorber has proved satisfactory for use in conjunction with catalytic polymerization and LPG production without subsequent deethanization of the propane. Another advantage of the deethanizing absorber is in the rejection of a large percentage of the hydrogen sulfide that would otherwise be recovered with high propane recovery operation. Thus not only can a high recovery of propane and propylene with very little ethane contamination be obtained but also the corrosion troubles in the downstream process equipment and the cost of treatment of the C_3-C_4 stream can be greatly lowered by the use of a deethanizing absorber.

The fractionating absorber has been defined[1] as a fractionating column in which reflux is generated by means of an absorption medium. In any such sep-

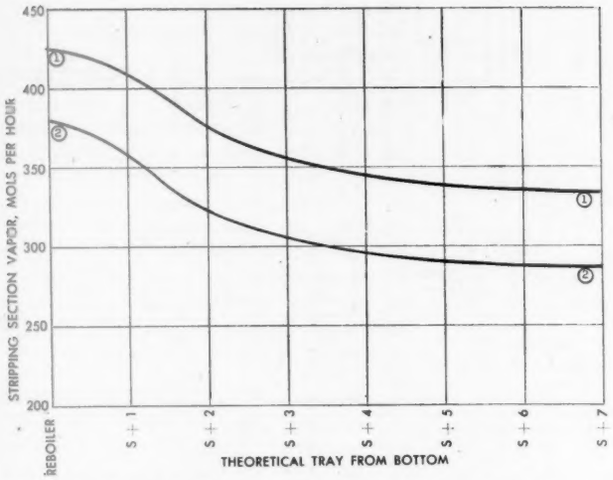


FIG. 12. Vapor boil-up rates in deethanizing absorber.

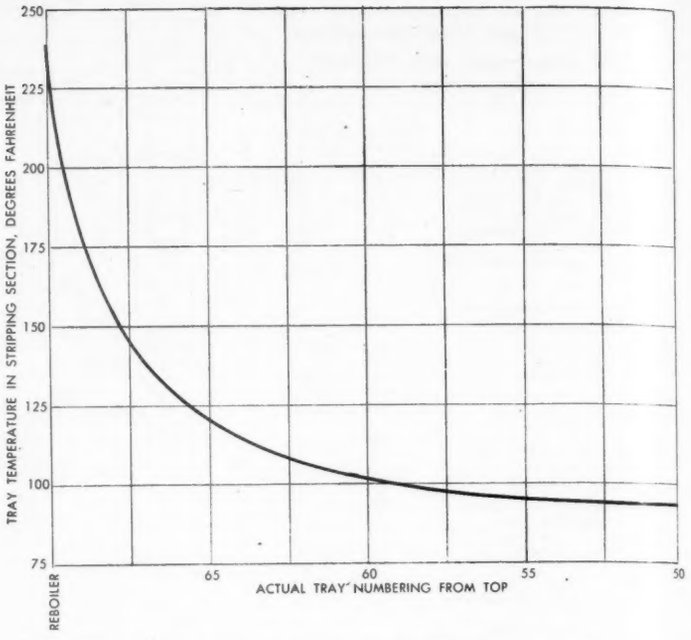


FIG. 13. Actual temperature gradient of stripping section in a deethanizing absorber operating at 150 psig.

aration process it is necessary to have a stream of recycle or reflux material present in order to obtain the desired separation. In a fractionating absorber this reflux is supplied by the hydrocarbons dissolving in the absorption oil. A reflux of this type can be increased only by an increase in either the lean oil circulation rate or by the overall effect of those factors, such as temperature and pressure, governing the amount of absorption obtained.

Fig. 11 shows a catalytic cracking gas plant that utilizes an extremely efficient fractionating absorber in its scheme of operation. This plant uses a partially stabilized straight run gasoline for lean oil and a heavy gasoline for sponge oil. Table 5 shows an actual material balance for the deethanizing absorber of this plant obtained by a test run when operating at propane-propylene recovery of 97.8 per cent. Even at this extraordinarily high propane-propylene recovery it was possible to condense totally all of the depropanzier overhead vapor and thus eliminate this recycle gas stream. The ethane-ethylene content of the depropanizer overhead liquid was about 3.0 mol per cent which is suitable for catalytic polymerization feed stock but would require additional deethanization for use as LPG or alkylation unit feed. There is no reason, however, why this deethanizing absorber cannot be made to work a little harder and thus produce LPG as the overhead liquid from the depropanizer.

Table 5. Molal material balance for deethanizing absorber.

Component	Stabilizer OH liquid M/H	Rich gas M/H	Lean oil M/H	Sponge oil M/H	Rich oil bottoms M/H	Dry gas to fuel M/H	Component recovery* Mol %
CO	—	4.4	—	—	—	4.4	0
H_2	—	69.5	—	—	—	69.5	0
N_2	—	25.1	—	—	—	25.1	0
H_2S	—	4.3	—	—	2.3	2.0	53.5
CO_2	—	12.0	—	—	—	12.0	0
C_1	—	131.4	—	—	—	131.4	0
C_2=	7.1	25.9	—	—	1.5	31.5	4.6
C_2	14.1	50.5	—	—	5.5	59.1	8.5
C_3=	72.9	62.8	—	—	132.6	3.1	97.8
C_3	24.1	29.2	8.4	—	60.3	1.4	97.8
C_4=	75.6	30.2	—	—	104.3	1.5	98.6
iC_4	53.0	21.1	9.4	—	81.7	1.8	98.0
nC_4	9.6	5.0	14.1	—	28.2	0.5	90.0
C_5	62.8	22.8	29.9	—	115.5	—	100
C_6+	—	—	932.5	151.0	1083.5	—	100
Total	319.2	494.2	994.3	151.0	1615.4	343.3	
B/H	80		392	60	584		
MSCF/D		4,490				3,120	
Absorption oil data							
°API			50.2	43.1			
Initial boiling point, °F.			126	320			
10% point, °F			202	332			
50% point, °F			300	346			
90% point, °F			368	382			
End point, °F			426	432			
Estimated molecular weight			124	140			

* Based on rich oil and dry gas.

Fig. 13 is a plot of the actual temperature gradient of the stripping section in the deethanizing absorber shown in Fig. 11 and during the test run for the material balance shown in Table 5. It is evident from an inspection of the temperature gradient that the bottom 5 to 10 trays were doing most of the deethanization while the remaining trays were serving mostly as a heat exchange section[2] and preventing the stripping heat from passing into the absorption section. This behavior is in agreement with the data of Goldblatt and Nelly[2] in that the operation of the absorption section is apparently independent of stripping section temperatures.

As the deethanization operation of the fractionating absorber is the most important factor in its use, it is well to take a brief look into the factors governing the extent of this deethanization. The main or controlling factor is the previously mentioned reflux or recycle material that makes the separation possible. In the deethanization step this reflux material is furnished by the reboiler and stripping section vapors. Fig. 12 shows the vapors rising from the stripping section trays at two different propane recoveries. These curves were calculated from the data of two test runs at the conditions and recoveries shown. Both of these curves follow the same general trend and indicate that equal molal boil-up is rapidly approached above the first four or five trays above the reboiler. These two curves also show by their relative positions that a considerable increase in the stripping vapors is required to lower the mol per cent of ethane in the rich oil bottoms from 2.4 to 1.4 per cent for the conditions shown. These curves also show that as the propane recovery is increased the temperature required to do the stripping is slightly decreased. This may be explained by the probability that at the higher recovery figure, more propane is made available to supply the necessary refluxing, or recycling operation, while at the lower propane recovery figure, these recycle vapors will probably have to contain a relatively high percentage of butane.

Theoretical tray calculations, based on the actual operation of the deethanizing absorber outlined in Fig. 11, show an average apparent tray efficiency for

Table 6. Component analysis* at various trays in deethanizer absorber operating at 150 psig.**

Component	Tray 65 Liquid Mol %		Tray 65 Vapor Mol %		Tray 59 Vapor Mol %	Tray 26 Liquid Mol %		Tray 20 Liquid Mol %
C_1	—		—		0.3	0.8		1.3
C_2=		M		M	6.2	0.9		2.0
C_2	M	9.4	M	51.9	53.8	5.9		7.2
C_3=		15.2		27.4	22.1	8.1		3.1
C_3		5.9		9.3	6.2	3.4		1.2
C_4=		4.2		2.8	M	M	M	
iC_4		8.0		6.2	M 10.5	M 13.4	M	2.5
nC_4		3.0		1.8	M	M	M	
C_5		1.5		0.4	0.9	1.9		2.0
C_6+		52.8		0.2	—	65.6		80.7
		100.0		100.0	100.0	100.0		100.0
Tray temp., °F		122			—	88		91

* Hydrocarbon only.
** Tower containing 70 trays, numbered from the top.

Table 7. Absorber comparison data at 150 psig operating pressure.

	Straight absorber*	Fractionating absorber**
Net propane recovery	90.0	90.0
Theoretical absorption trays	10	10
Average absorption temp., °F	110	110
Rich gas feed, mols/hr	1350	1350
Lean gas to fuel, mols/hr	636	723
Gas shrinkage, mols/hr	714	627
Rich oil rate, mols/hr	1802	2267***
Lean oil rate, mols/hr	967	1523
Net absorption, mols/hr	835	744
Propane in lean gas, mol %	5.3	4.7
Ethane and lighter in rich oil, mol %	4.7	0.2***

* No recycle gas to absorber—i.e. same raw feed gas as fractionating absorber.
** For production of LPG.
*** Kettle product.

the bottom five actual stripping trays of about 80 per cent. These agree with the temperature gradient shown in Fig. 13 and the data of Fig. 12 in that the bottom 5 to 10 trays in the stripping section accomplish practically all the deethanization.

Table 6 shows stream analysis data at various points in the deethanizing tower when operating at the conditions shown in Table 5. These data, while not conclusive enough to present any concentration gradients for the various components throughout the deethanizing absorber, do stimulate some speculations regarding possible future use of fractionating absorbers, such as the withdrawing of a vapor or liquid sidestream from some point of the deethanization section. A fairly concentrated ethane-ethylene or propane-propylene stream could be obtained in this manner for feed to a catalytic conversion process and in this way eliminate several processing steps that might be required otherwise. Also by withdrawing such a vapor sidestream the absorber could be unloaded partially of its vapor load thus increasing propane extraction.

The operating expenses of a deethanizing absorber may seem somewhat high at first glance because the lean oil rate may be 50 to 60 per cent greater than to a straight absorber for the same propane recovery. A comparison between a deethanization absorber and a straight absorber, without a gas recycle stream is shown in Table 7. In this comparison, about 58 per cent more lean oil is required for the deethanizing absorber to obtain the same initial propane recovery as in the straight absorber. The high oil rate required for the deethanizing absorber, however, does not appear so excessive when compared with the extra cost of using a reabsorber or a high pressure deethanizer with a straight absorber in order to maintain the initial high propane recovery and yield a propane stream of comparable quality. Also, the necessary recycling of the high pressure deethanizer overhead gases to the straight absorber will require an increased oil circulation to maintain the same high propane extraction. The lean oil to a deethanizing absorber may be said to function not only as the primary lean oil but also as the lean oil for the reabsorber and as reflux for a partial deethanizer. Consequently, the deethanizing absorber may combine the functions of three towers into one tower and at a total oil circulation rate that is no greater than the combined oil and reflux rates for these separate towers.

Revamping Existing Gas Plants To a High Propane Recovery

For the most part the previous discussion has dealt with various methods of increasing or maintaining a high propane-propylene recovery in oil absorption plants. It is now advisable to briefly summarize how some of these schemes may be applied to the revamp of an existing unit so as to increase the recovery of propane and propylene. A few of the more obvious and easier methods that should be compared for the plant under consideration are listed below:

1. Increasing the lean oil circulation is perhaps the easiest single method of obtaining a higher propane-proylene recovery *provided*, the absorber and subsequent fractionators, reboilers, and coolers are of sufficient size to handle this additional liquid load. The use of a lighter absorption oil is particularly beneficial when one of the factors listed above is found to limit the oil circulation rate. The dotted line on Fig. 1 shows a very easy method of obtaining a light absorption oil for use over the absorber in a catalytic cracking unit. The use of a light absorption oil, however, necessitates the use of an adequate sponge oil section to eliminate the loss of gasoline hydrocarbons to the lean gas.

2. Maintaining a lower average absorption temperature by refrigeration of lean oils, feed gases, and intercoolers is a very advantageous means of increasing the propane-propylene recovery in an existing plant, but its justification for a new plant is doubtful. If the recovery of ethylene is desired, however, refrigeration will have to be employed in order to keep the lean oil requirements within reason.

3. In some plants the absorption pressure can be increased but usually it will have to remain the same or be lowered. This latter possibility may be one reason why the initial recovery of propane and propylene has fallen off in catalytic cracking unit gas plants because as the corrosion allowance of the equipment becomes less the operating pressure must be lowered. For this reason some other method, rather than an increased pressure, must generally be used to achieve the desired recovery figure.

4. Reboiling of the primary absorber, when the capacity of the absorber will permit it, and converting the bottom 5-10 trays of the absorber into a deethanizing section may prove to be advantageous. These alterations to the primary absorber will make it possible to eliminate the gas stream that must be recycled either to the primary absorber or reabsorber, or disposed of as fuel gas

KEROTEST

NEEDLE VALVES

FORGED STEEL *for* HIGH PRESSURE AND CORROSIVE SERVICES

Globe and angle types in specific materials for ordinary or corrosive services. 8000 lb. working pressures at 150 deg. F. Safety union bonnet design permits packing under pressure. Conical stem tip gives micrometer throttling action. Sizes ⅛" to ¾".

Write for descriptive bulletin 49-N

KEROTEST MANUFACTURING COMPANY
Pittsburgh 22, Pa.
New York Chicago Charleston, W. Va.
Tulsa Odessa Houston Los Angeles
St. Louis Toledo Richmond Baltimore

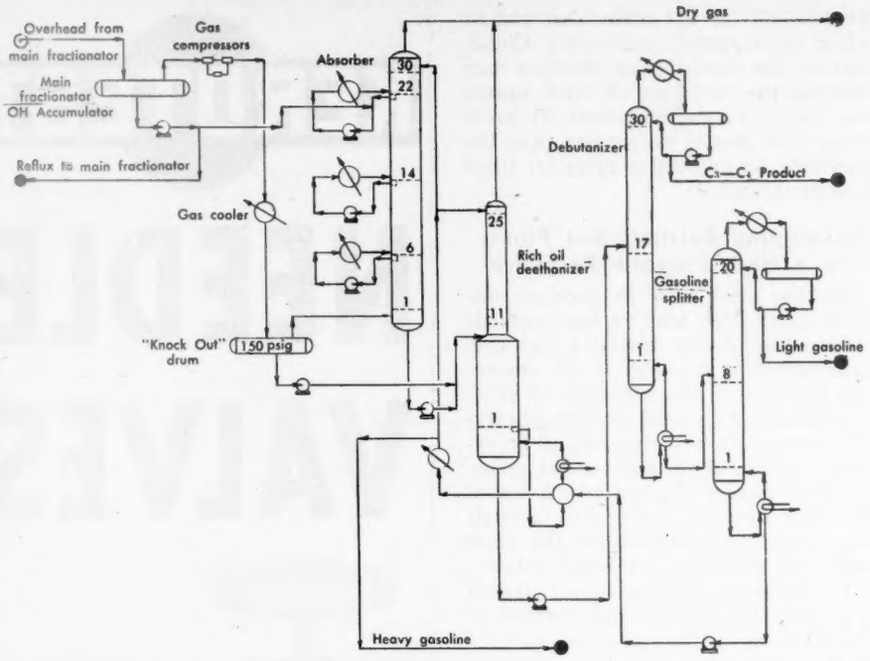


FIG. 14. Catalytic cracking unit gas plant with rich oil deethanizer.

and thus lower a possible source of propane-proylene losses.

5. If the existing absorber does not have sufficient liquid capacity to handle the increased lean oil rate required for the fractionating absorber's operation, a separate rich oil deethanizer may be used in place of the fractionating absorber. A rich oil deethanizer allows the primary absorber to be loaded to its maximum liquid handling capacity and thus set the maximum propane-propylene recovery obtainable as the deethanization of the rich oil is carried out in a separate column. The absorber of the gas plant shown in Fig. 1 was found to be of the type mentioned above in that the liquid handling capacity of the absorber was the limiting factor and consequently this absorber could not be easily converted into a fractionating absorber. Fig. 14 shows how a rich oil deethanizing scheme was worked into the plan of operations for this plant. The absorber is to be loaded to its maximum liquid handling capacity thus setting the initial recovery of propane and propylene. The rich oil from the absorber is then deethanized in the rich oil deethanizer with a minimum loss of propane and propylene to fuel gas. The deethanization accomplished in the rich oil deethanizer is sufficient that the debutanizer overhead yield may be totally condensed at 125 psig, thus eliminating the previous recycle gas stream. The calculated recovery of propane for the unit revamped as shown in Fig. 14 was 89.6 per cent. The degree of deethanization of the C_3-C_4 product stream although not enough for LPG production or alkylation unit feed is very satisfactory for its intended use as catalytic polymerization unit feed.

The following table summarizes for the original gas plant shown in Fig. 1 the calculated propane recoveries that would result from the revamped operations shown in Fig. 1 and 14.

	Propane Recovery, mol %
Original—Fig. 1	65%
Revamped lean oil system—Fig. 1	80%
Rich oil deethanization—Fig. 14	90%

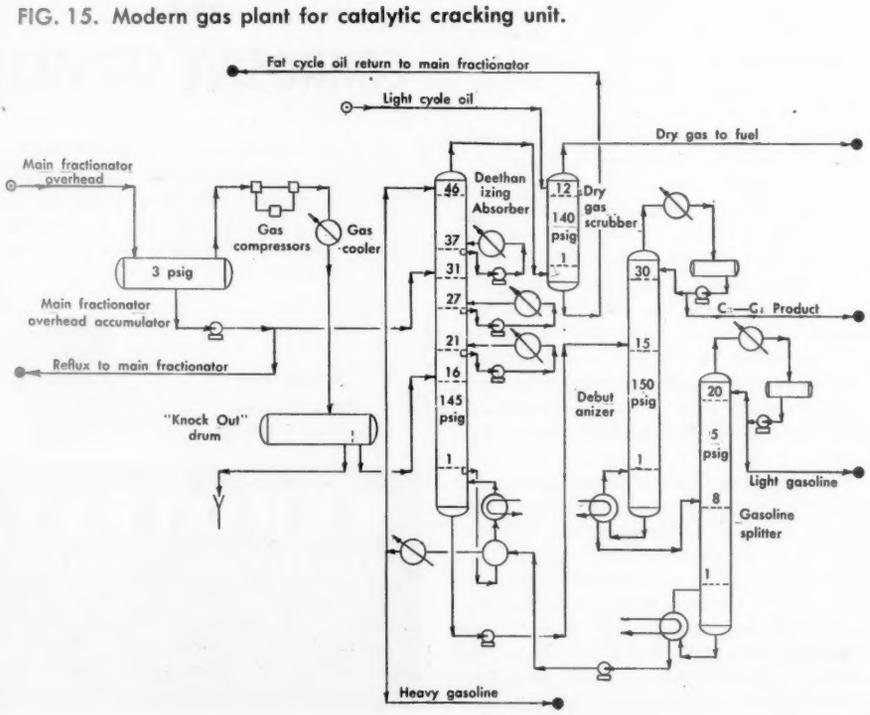
The exact choice as to which type or types of revamp to apply to a particular plant is a specific problem and must be treated individually for each plant under question. The final choice must be made from an economic as well as operational viewpoint. In the case shown above the estimated cost in going from 80 to 90 per cent recovery is many times as much as the cost that was incurred in going from 65 to 80 per cent recovery. While this additional cost may be justified for one plant, another plant may find the cost too great for the second step and advantageously choose to operate at 80 per cent recovery.

Conclusion

In addition to the above considerations, other factors such as the compressor horsepower costs, plant investment, corrosion problems, value of the product, and the availability and cost of fuel, steam, and water also affect the choice of plant or type of revamp to be used. Often the cost of fuel gas in the plant's area will determine the optimum propane-propylene recovery figure. The capacity of the plant is still another factor to be coped with inasmuch as oversized or idle capacity is a costly item. All of the above factors as well as those factors governing the plant's recovery must be carefully considered and studied before the economic optimum design can be determined.

The design of a modern gas plant, representing probably the latest trend in such plants, is shown in Fig 15. This plant has been designed to recover 90 per cent of the total C_3's with a negligible loss of gasoline boiling range hydrocarbons to the fuel gas. Salient features of this design are the use of a deethanizing absorber, a low molecular weight primary lean oil, adequate sponge oil facilities, and the elimination of all recycle gas streams from the fractionating equipment.

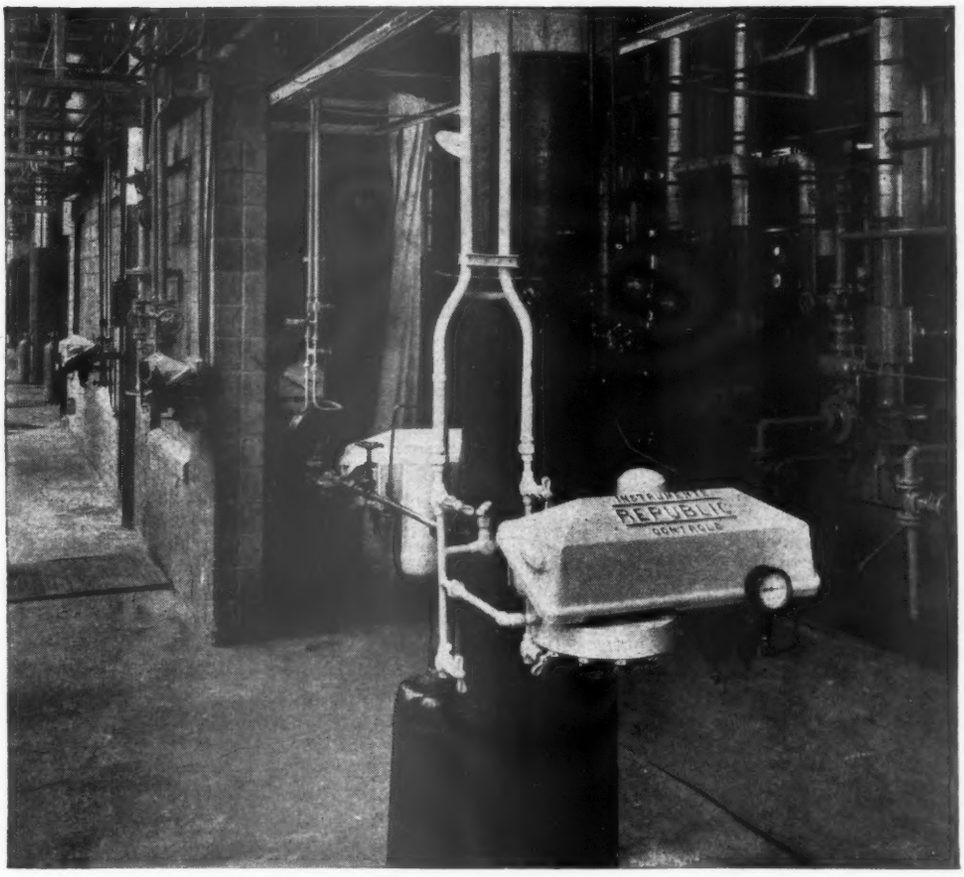
FIG. 15. Modern gas plant for catalytic cracking unit.



Bibliography

1. Hannah, J. C., Petroleum Refiner, Vol. 28, No. 8, August, 1949.
2. Goldblatt, S. and Nelly, Jr., H. M. Petroleum Refiner, Vol. 28, No. 11, November, 1949.

* * *



These Meters Had To Be
ACCURATE—FLEXIBLE—RUGGED

One hundred twenty one Republic Pneumatic Transmitters are measuring the flow and level of various acids in a large chemical processing plant, a section of which is pictured above.

These transmitters have a guaranteed accuracy of within ½ of 1% of the transmitter range. By making a few minor adjustments or substituting a few small parts, their operation can be easily changed to any desired range between a minimum of 0—0.6″ of water to a maximum of 0—704″ of water. Their construction is more like that of a precision machine than of the sensitive instrument they are. It is for these reasons that Republic Pneumatic Transmitters, even though comparatively new, have already been specified and installed on over 2500 industrial metering applications.

Republic Pneumatic Transmitters are available for measuring flow, liquid level, pressure or liquid density of a wide range of fluids. They employ the force-balance principle to convert these process variables into air pressures which vary proportionately. These air pressures become direct measurements and can be conducted to reading instruments or used as the measuring impulse for the actuation of an automatic controller.

Data Book No. 1001 contains complete details on the construction and operation of Republic Transmitters. Write for your copy today.

REPUBLIC FLOW METERS CO.
2240 Diversey Parkway, Chicago 47, Illinois

Your questions on refining and gas processing problems answered here. Send yours in today!

The Technical Forum

Removal of Boiler Scale

Q We have a small steam boiler that has been operated on fairly hard water, in which the temporary hardness is about six times that of the permanent hardness; presumably the heavy scale in the boiler tubes and drums is of the same approximate ratio of carbonates to sulfates. What method is best for cleaning such a boiler of scale? I should appreciate discussion of this subject and problem.
L. C. M.

A If optimum boiler cleaning results are desired, the "cleaning" procedure should include three distinct steps: (1) cleaning, for the removal of soil or other foreign matter; (2) acid descaling and; (3) surface neutralization to forestall residual acid attack.

Boilers in service occasionally become fouled accidentally due to worn boiler feed pump packing or an oil contaminated water supply. In either case, thorough cleaning is mandatory for the removal of oil films that can act as a barrier between the scale to be removed and the descaling medium. Over a period of years, the following complete procedure has been found effective:

1. Determine the boiler's water capacity to its highest point, usually the safety or blow-off valve. This volume capacity information can readily be secured from the manufacturer's service manual.

2. Fill the boiler half full with clear water.

3. Make up a well dissolved concentrated solution of an alkaline-cleaning compound. This chemical detergent should possess very high factors of solubility and positive emulsification. Then, pour the concentrated alkaline cleaning solution into the boiler so that the working concentration will result in a minimum concentration of four ounces per gallon of free alkalinity as determined by chemical titration methods. Fill the boiler to the highest point.

4. Remove the safety blow-off valve and insert a thermometer (on the end of a wire) into the boiler, if the boiler has no thermometer provision.

5. Start the fire and maintain temperature of the boiler cleaning solution at 180 to 200 F for four to six hours, or longer if conditions warrant.

6. Introduce *hot* water into the lower portion of the boiler so that the emulsified oil floating on top of the cleaning solution flows out the top of the boiler or drum opening. For this purpose, provide drainage piping from the safety valve or top opening to prevent the oil and cleaning solution from spilling all over the boiler surfaces.

Continue this hot flush-rinse until the water runs clear from the boiler.

7. When traces of oil no longer flush from the boiler, (a) cease flush-rinsing, (b) drain the boiler to the water working level, (c) replace the safety valve, and (d) remove drainage piping and close all open boiler connections.

8. Generate steam pressure.

9. Open blow-down valve periodically until all solid matter from the boiler bottom is cleared. Maintain the proper water working level during this blowing down operation to prevent the boiler from operating below the standard water level.

Extinguish the boiler fire and allow the boiler to cool. Then drain all traces of cleaning solution and follow with a thorough flush rinse.

Caution: Never dump dry cleaning compound into a boiler. It is liable to "ball up" or become trapped in a blind spot causing "hot spots" or burned out areas after the boiler is returned to service.

Before descaling the boiler, it should be drained fully and all areas possible inspected for corroded or weak points. Quite often a boiler tube, jacket, or other critical surface will reveal no leaks if liberally deposited with scale. When the descaling acid is introduced into the boiler, under these circumstances, the leak may then become apparent due to the scale plug being dissolved.

Any acid introduced into a boiler for descaling purposes, should be adequately inhibited against attack on steel.

Even the best descaling acids are usually not effective in opening up plugged boiler tubes.

The best boiler descaling results are usually secured by rigging a small circulating acid solution system. Acid-proof pumps, of course, are preferable but it is oftentimes more economical to employ an inexpensive cast steel pump and then write it off as the cost of part of the job. The inhibited acid solution should be introduced into the boiler at the lowest possible point. Adequate venting should be provided for at the boiler top to permit ready escape of any hydrogen or hydrogen sulfide gas formed as a result of the chemical reaction between acid and scale. All open flames should be kept away.

In circulating the descaling acid from the boiler bottom up through the tubes and to the drum and back to its point of origin, the circulation rate should be kept well under 31 ft per second. To dissipate gas pockets, it has been found good practice to cease circulation for 20 minutes out of every hour.

Due to the fact that a known concentration acid strength was used at the beginning of the descaling procedure, chemical titration performed periodically will reflect the rapidity with which the descaling procedure is progressing. When a relatively high titration reading is maintained over a period of 20 minutes to one-half hour, the descaling procedure may be considered as complete. The descaling solution should then be dumped and followed by fresh water rinsing, without delay, for 45 minutes to one hour. The boiler should then be drained fully and an alkaline solution circulated through the boiler in the same manner as which it was cleaned for a minimum of one hour. This latter step will assure alkaline neutralization of any residual acid pockets.

The alkaline neutralization solution should then be drained and be followed by a fresh water rinse for one-half hour in volume. At this point it is well to drain the boiler and perform an inspection if any weak spots are suspected. If conditions observed are satisfactory, the boiler may then be returned to service.

Boiler descaling and cleaning is a specialized field of endeavor and it would be well for the owner to contract the job to concerns organized and qualified to handle the job as well as being insured against possible subsequent liability. If the owner decides to perform the cleaning and descaling procedures himself, he must be prepared to take full responsibility. Under these circumstances, technical service representatives of reputable chemical cleaning compound manufacturers will prove of invaluable assistance.

Vincent E. Bowes.

MEASURE MORE

THE ROCKWELL ORIFICE METER WAY

THE ROCKWELL INTEGRATOR

Calculates CHARTS WITH MACHINE PRECISION

The operator of a Rockwell integrator mechanically computes the total extension of simple flow meter charts by tracing colored lines over the pressure and differential chart records as made by the meter. The total appears on a direct reading counter, accurate to ½ of 1 per cent or closer. One machine will calculate up to 300 average charts a day.

. . . WITH LESS MAINTENANCE, LOWER COSTS

Set your sights high and you'll look at a Rockwell orifice meter. You will see a design with stronger parts, better construction. For example, Rockwell orifice meters have a new Teflon bearing stuffing box. This unit never leaks, never needs lubrication. They have positive inking pens that eliminate blurred or unprinted records.

Consider, too the advantage of a unit manometer construction that permits you to interchange high side chambers at will and adapt any range meter to higher or lower differential requirements. This feature can save you plenty on your inventory of complete meters.

You'll also save plenty on routine maintenance, for the Rockwell meter can be disassembled with the simplest tools. Now's the time to look into all the advantages of this superior design. Write the nearest Rockwell office for eye-opening information.

ROCKWELL MANUFACTURING CO.

PITTSBURGH 8, PA.—Atlanta • Boston • Chicago • Columbus
Houston • Kansas City • Los Angeles • New York • Pittsburgh
San Francisco • Seattle • Tulsa

NEWS

California to Have First Synthetic Phenol Plant

Plans for construction of the first synthetic phenol plant in the West have been announced by T. S. Petersen, president of Standard Oil Company of California. Petersen said the new plant, to be built at the company's Richmond, California, refinery, will cost approximately $4,000,000.

The manufacture of phenol at Richmond will utilize a recently-developed synthesis process in which neither sulfuric acid nor chlorine is used. Both of these chemicals, now listed as scarce materials, are used in present commercial processes for the manufacture of phenol.

Principal uses of phenol are in the manufacture of resins for moulded plastic parts, and in plywood adhesives. Other uses for synthetic phenol are as an intermediate in the manufacture of dyestuffs, insecticides, and many other compounds.

New Offices Announced

Witco Chemical Company and Continental Carbon Company have announced the removal of their offices to 2284 West Holcombe Boulevard, Suite 209 in Houston, Texas.

New Underground Storage Feature LPG Conservation

One of the largest underground projects employed in the storage of liquefied petroleum gases in the nation is in the operation adjoining the new Scurry County, Texas, gasoline plant of Sunray Oil Corporation and associates. Sunray as operator for itself and 30 other companies and 60 individuals in the Scurry gasoline plant, operates three storage "wells", which afford access to a man-made underground "savings bank" with a combined capacity of 3,700,000 gal. These artificial subterranean caverns are equivalent to the capacity of two huge steel storage tanks seen on crude oil tank farms. Sunray contemplates doubling the storage facilities within the next year.

Above ground storage, which requires handling of pressures ranging from 50 to 225 psig for LPG, costs in the order of $20 per bbl. Thus to store 60,000 bbl of LPG in steel spheroidal tanks aboveground an investment of $1,200,000 would be required involving more than 3000 tons of steel.

In contrast, underground LPG storage costs from $1.25 to $1.50 per bbl, or about 15 per cent of the above figures. Moreover, the only steel requirements are the casing, tubing, and wellhead equipment.

In order to create artificial underground storage suitable for storage LPG, Sunray engineers cored the shallow Permian formations that underlie not only Scurry oil field but nearly all of the West Texas basin. At a depth of 630 ft, a section of evaporites was found with a thickness of nearly 600 ft. Individual layers of solid crystalline salt were found to occur in thicknesses from 2 to 22 ft. Interspersed within these salt layers were a mixture of red beds, insoluble anhydrites, and shales.

A string of casing was set at a depth of 630 ft. Surface equipment was installed to inject fresh water through the tubing string into the Permian salt beds to wash out a huge underground cavity. In the first well, 198,000 bbl of fresh water were employed to dissolve an estimated 25,000,000 lb of salt. The brine which contained the salt dissolved from the salt series was conducted to an open asphalt-lined surface storage pit having a capacity of 200,000 bbl; in this fashion contamination of surface water supplies was prevented. In a like manner, two other wells were completed to create man-made underground caverns with a capacity sufficient to handle up to 89,000 bbl of liquefied petroleum gases.

Research Reports Condensed

The Technical Microcard Publishing Corporation, which has published a number of the basic German chemical periodicals in microcard editions, announces that it is prepared to reproduce research reports, engineering data, etc., on microcards. Sixty letter-size pages can be reproduced on one small card, 3 by 5 in. in size, and 100 such cards occupy only one inch of file space, representing a tremendous saving. By means of a small, portable device each of these 60 pages can be quickly increased to its original size for reading purposes.

French Chemicals Plant Set

A new petroleum chemicals plant is being planned in southern France, according to Anglo Iranian Oil Company, Ltd. It is being built by Societe Generale des Huiles de Petrole B.P. The plant is being built near the L'Avera refinery, which will supply the required feedstock. The plant will be owned by Naphtachimie in which SGHP is a partner with Pechinery and Kuhlmann.

Iraq Will Get First Refinery Next Year

The first quarter of next year will see the beginning of construction of Iraq's first national oil refinery, a government-owned project.

The plant is to be built south of Baghdad, on the city's right bank, and is designed to produce 24,000 bbl of refined oil a day. Although this will meet Iraq's consumption for the next seven years at least, future expansion has not been taken into account.

M. W. Kellogg is building the plant, which will take three years to complete.

India Refinery Discussed

Standard-Vacuum Oil Company has reported in response to reports published in New Delhi, that it is negotiating with the Government of India for the construction of an oil refinery in that country. A company spokesman stated, however, the New York office had no knowledge of official government approval of the project.

Standard-Vacuum is currently making extensive additions to plant and equipment at its inland bulk storage and ocean terminal facilities that serve the public of India, under an expansion program costing several million dollars.

As **Herschel C. Smith,** president of Mexican Petroleum Corporation and American Oil Company, and other company officials look on, Governor W. Kerr Scott of North Carolina turns a valve to begin operations at the new MexPet asphalt refinery at Wilmington, North Carolina. With Smith are John Marshall, secretary to the governor; F. G. Heath, manager of the North and South Carolina area of MexPet; Sidney J. Boudreaux, Sr., superintendent of the Wilmington refinery; and Governor W. Kerr Scott. The new plant, with a daily capacity of 750,000 lb of asphalt serve the road builders of North and South Carolina.

Make H_2SO_4 from H_2S

WITH A CHEMICO PLANT

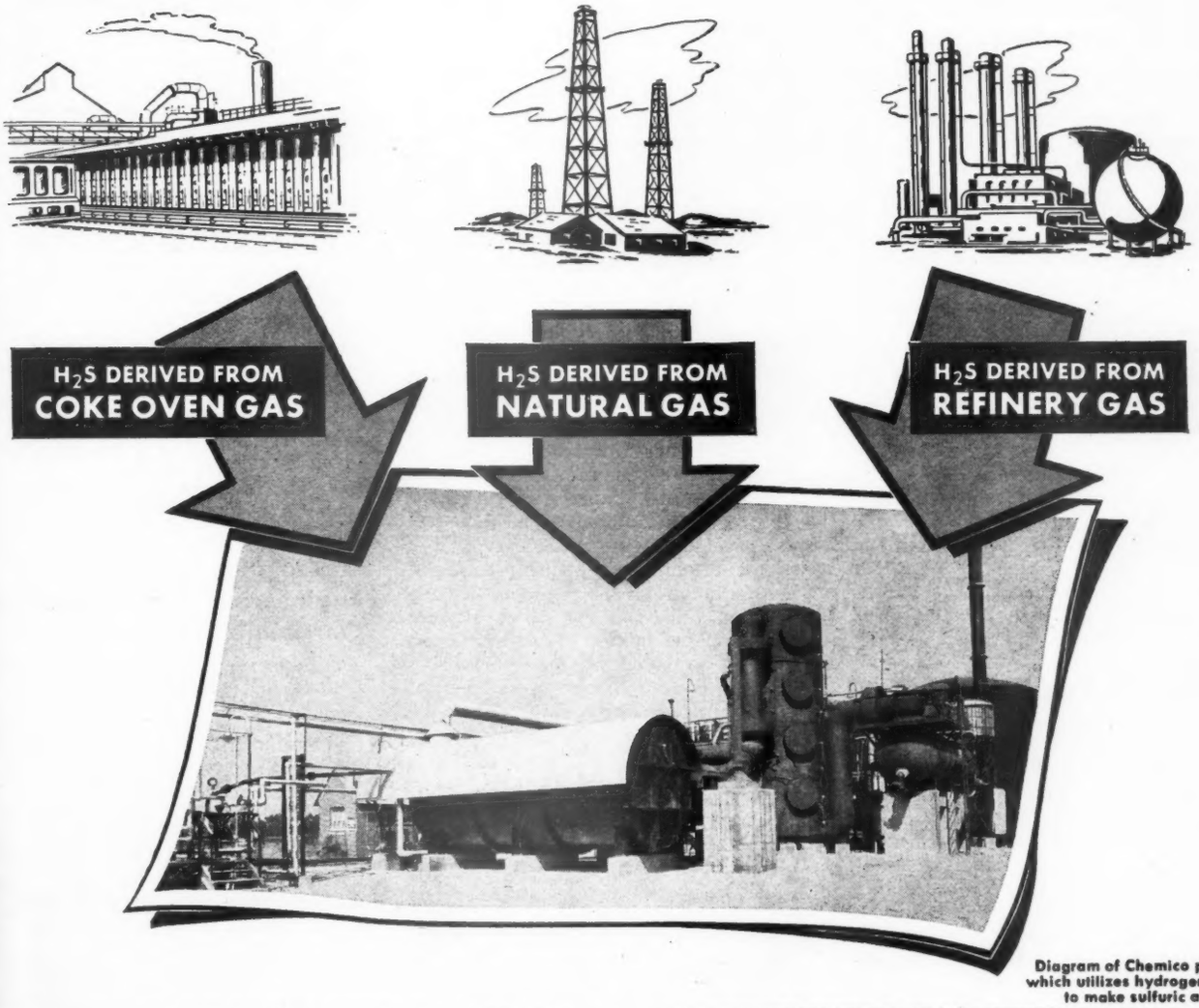
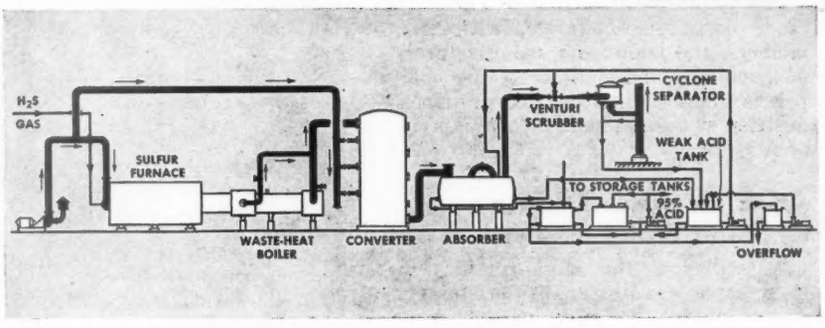


Diagram of Chemico process which utilizes hydrogen sulfide to make sulfuric acid.

Now that raw sulfur is in short supply, it has become necessary to manufacture sulfuric acid from other raw materials such as hydrogen sulfide. If you have hydrogen sulfide available, it will pay you to investigate Chemico's practical and proven process for making H_2SO_4 from H_2S. Chemico's new type sulfuric acid plant is especially well suited for this purpose. Or existing sulfuric acid plants can be converted.



CHEMICAL CONSTRUCTION CORPORATION

A UNIT OF AMERICAN CYANAMID COMPANY

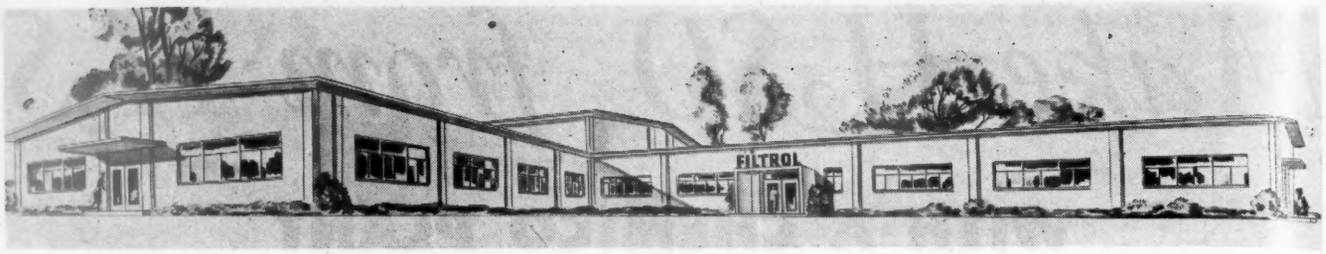
488 MADISON AVENUE, NEW YORK 22, N. Y.

EUROPEAN TECHNICAL REPRESENTATIVE: CYANAMID PRODUCTS, LTD., LONDON W. C. 2, ENGLAND

CABLES: CHEMICONST, NEW YORK

3C213

Chemico plants are profitable investments



Filtrol Corporation's new research laboratory now under construction.

Filtrol Announces New Research Laboratory

Filtrol Corporation, producer of petroleum cracking catalysts, adsorbents and related products, announces construction of a new 16,000-sq ft research building to house its varied and greatly expanding research activities. The new research building will incorporate advanced facilities for conducting research in product development and for efficient use of Filtrol products in the many industries the company serves throughout the world. The research building is being constructed by the general contracting firm of McIsaac, Menke and Roach of Los Angeles and will be situated adjacent to Filtrol's Vernon manufacturing facilities.

It is a tilt-up type wall design and will be constructed of reinforced concrete slab with poured columns and roof beams. Individual laboratories and offices will be separated by fire-proof walls of metal stud and plaster construction. Completion is expected before the middle of 1952.

Plastics Meeting Planned

Space has been allotted to 110 exhibitor companies at the fifth national Plastics Exposition to take place in Exposition Hall, Philadelphia, Pennsylvania, March 11-14. The Society of the Plastics Industry, Inc., sponsoring the meeting, has announced that meetings will be held in the ballroom adjoining Exposition Hall, and that the Bellevue-Stratford, has been designated as the headquarters hotel during the exposition.

Exhibitors at the 1952 show will include plastics maufacturers, fabricators, molders, and laminators, manufacturers of machinery and equipment, and companies representing the scores of industries whose products involve the use of plastics.

AIOC Increases Capacity Of South Wales Refinery

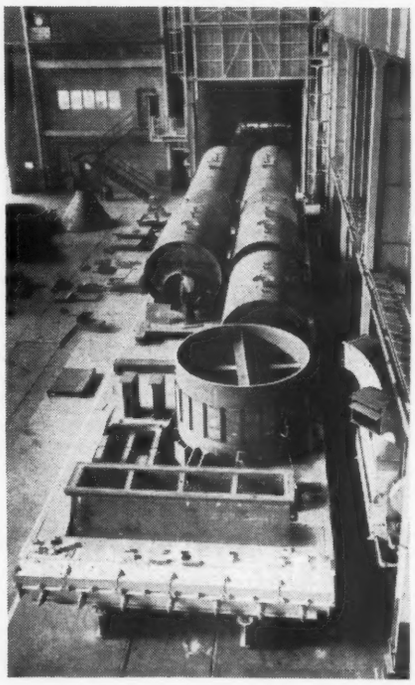
According to the Anglo-Iranian Oil Company Newsletter, its Llandarcy (South Wales) refinery has increased its refining capacity from a rate of 3,000,000 tons a year to the present total of 4,000,000 tons, or 28,000,000 bbl. The Newsletter added that the refinery had increased production 12-fold since 1939.

Along with the increased capacity for production at Llandarcy major developments are taking place to increase production of high grade petrol and lubricating oil. A catalytic cracking plant with a daily throughput of 12,000 bbl (600,000 tons per annum) is being installed for high grade petrol production. This unit is similar to the two being installed simultaneously at the AIOC refineries at Grangemouth and Isle of Grain (Kent Oil Refinery Ltd.). The installation of the "cat cracker" will result in the production of considerable quantities of gas. Although some of this gas will be used as fuel within the refinery, the bulk of it will be supplied to the South Wales Gas Board to augment the supplies to the Gas Grid, which is now under construction for supplying fuel to the industries in South Wales.

Also being erected at Llandarcy is a line of modern lubricating oil plants which, in due course, will double the present output of lubricating oils.

Extra steam and power have had to be provided by the construction of a new boiler and power house. Cooling of the products from the crude oil distillation and other plants, which require 70,000 gal per minute of cooling water, is being provided by the erection of three concrete cooling towers—two of which already stand high above the refinery.

Canada's largest stress relieving furnace of Dominion Bridge Company, Montreal.



BA to Build Grease Plant

The British American Oil Company Limited has announced plans for the construction of a new $1,500,000 grease plant at its refinery at Clarkson, Ontario. The plant is to have a capacity of 15,000,000 lb yearly and will reduce to a minimum the quantity of greases at present being imported by the company from the United States.

Construction of the plant, which will be British American's first major grease manufacturing installation, is expected to be completed late in 1952. It will be equipped to manufacture a full range of automobile, industrial and aviation greases.

The plant's packaging equipment will all be on a weight-controlled basis, thus ensuring packed products of full measure. The building housing the plant is to be of concrete block, 250 ft long by 100 ft wide.

Engineering Now Underway On Chile's First Refinery

Engineering has been initiated on Chile's first refinery, according to an announcement made by The M. W. Kellogg Company, refinery and chemical engineer-contractors of New York City. It will be situated at a site about 10 miles north of Valparaiso.

Kellogg, awarded the contract by Empresa Nacional Del Petroleo in October for the $10,000,000 refinery, estimates that actual construction will begin under the direction of its subsidiary, Kellogg Pan American Corporation, in about a year. The refinery, a complete 20,000 bbl per day plant, will employ the most modern type of combination thermal processing equipment to produce several petroleum products from either indigenous or imported crude oils.

With the exception of special facilities for the preparation of liquefied petroleum gases, the refinery is quite similar—although larger in capacity—to one completed by Kellogg in Brazil.

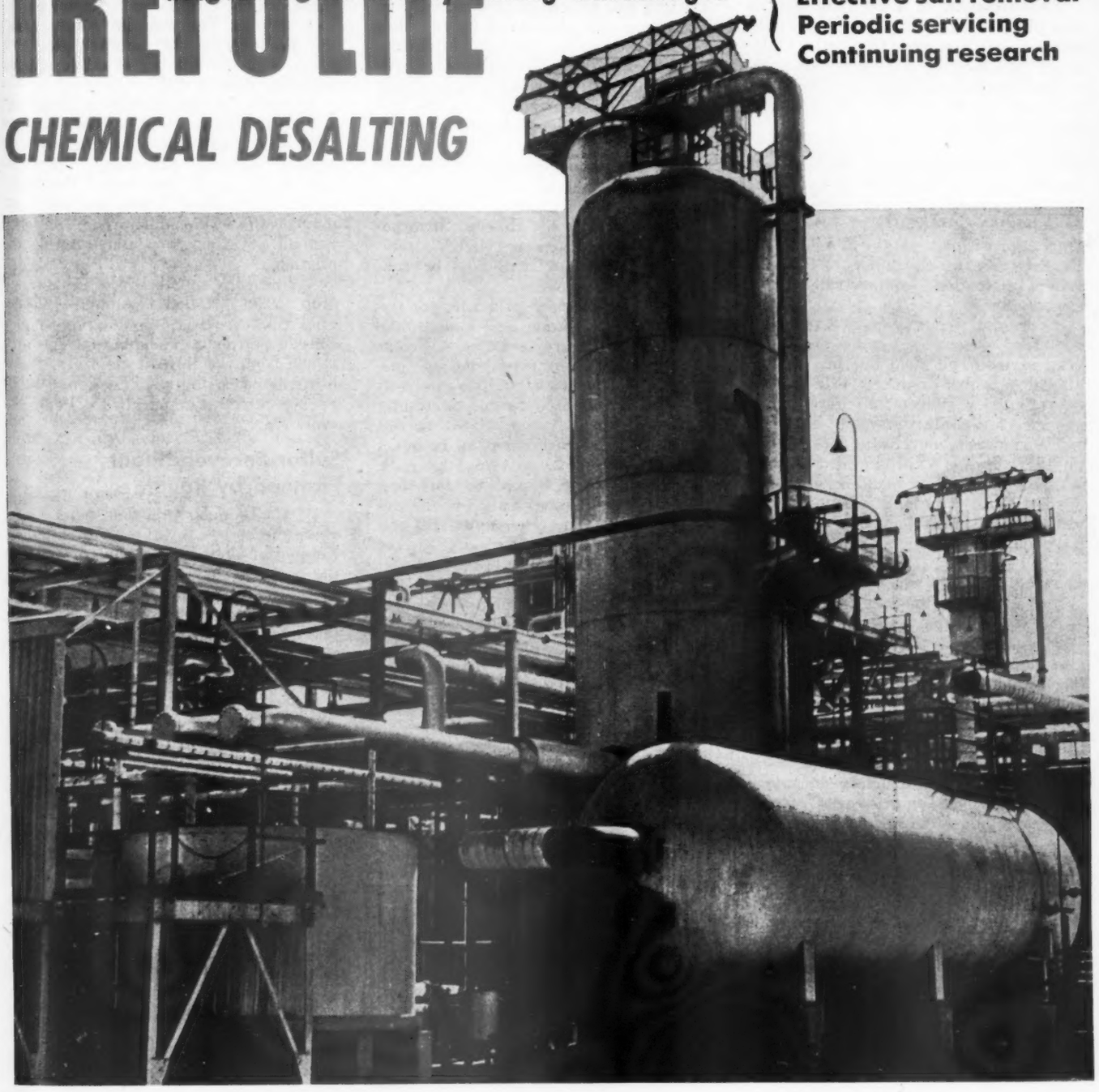
Products from the Valparaiso plant will include, aside from liquefied petroleum gases—motor gasoline, tractor gasoline, kerosine, two grades of diesel oil, and heavy fuel oil. Process facilities in the combination unit comprise crude oil distillation, vis-breaking, thermal reforming, thermal cracking, gasoline stabilization and treating equipment for sulfur removal from fuel gas, liquefied petroleum gases, and gasoline.

TRETOLITE

CHEMICAL DESALTING

assures these money-saving advantages

- Low installation costs
- Low operating costs
- Effective salt removal
- Periodic servicing
- Continuing research



HIGH EFFICIENCY

LOW COST

In many of America's leading refineries Tretolite desalting is delivering salt removals as high as 90 to 95%. The low water requirement seldom exceeds 5 to 8% of the total volume of the crude charge. Tretolite desalters now in use range in capacity from 2,000 to 50,000 barrels per day per plant, since Tretolite desalting is adaptable to either large or small refining operations. Periodic checking by Tretolite desalting engineers insures that your Tretolite desalting process stays at top operating efficiency.

The recognized economy of Tretolite desalting is due to the high flexibility of the process. This process flexibility often permits the use of existing refinery equipment as part of the desalting installation, obviously holding installation costs at a minimum. This low installation cost, plus the low water, heat and chemical requirements, helps to hold Tretolite desalting cost per barrel at a minimum.

TRETOLITE COMPANY *Chemicals for the Petroleum Industry*

ST. LOUIS 19, MISSOURI • LOS ANGELES 22, CALIFORNIA

DESALTING • DEHYDRATING • WATER DE-OILING • CORROSION INHIBITION • SCALE PREVENTION

TD 51-1

Sunray Plans to Begin Its Alkylation Unit

Rehabilitation of a dormant alkylation plant at the Sunray Oil Corporation refinery at Sunray (Duncan), Oklahoma will begin immediately and the unit should be in production within approximately 10 months, it was announced recently.

Sunray has received a Defense Production Administration certificate of necessity to cover alkylation equipment at the refinery and will use Sunray capital of about $1,750,000 for the work. Under provisions of the 1950 U. S. Revenue Act, which applies to this Defense Production Administration certificate, Sunray will be able to depreciate this defense project investment more rapidly than normally over a 5-year period. The 2000 bbl per day of alkylates to be produced will be delivered under contract to government agencies for military use.

The refinery, purchased by Sunray in 1947, formerly produced alkylates for aviation gasoline blending purposes during World War II. It was not reactivated when Sunray took over the plant for production of high octane catalytic cracked gasolines. The redesigned Sunray alkylation unit will produce 115-145 grade aviation alkylate highest grade airplane motor fuel components.

Scheduled new work at the refinery also includes increasing the capacity of the catalytic cracking unit. The improvements will increase production of propylene tetramer, currently in short supply as a modifier in the cold rubber process and as a base stock for the manufacture of industrial detergents.

In the proposed improvement of catalytic cracking facilities, which will be done by the Refinery Engineering Company of Tulsa, the catalytic blower will be remodeled to supply a larger quantity of air for regeneration of the cracking catalyst. The regeneration capacity will be increased from 14,000 lb per hour carbon burning capacity to approximately 20,000 lb per hour carbon burning capacity.

Roosevelt Oil Builds New Refining Equipment

Construction of a new platforming, catalytic, and special extraction unit for production of benzene and toluene has just been started at the Roosevelt Oil and Refining Corporation in Mount Pleasant, Michigan, according to an announcement by J. E. Boudler, president of the firm.

The three units will produce 3,000,000 gal of benzene, ASTM industrial grade D 836-47 and 3,250,000 gal of toluene, ASTM industrial grade D 842-47 per year. The first unit, the platformer, is specially designed to produce benzene and toluene from a narrow boiling range (150 to 220 F) cut, derived from desulphurized straight run crude oil stocks produced by Roosevelt's existing equipment. The catalytic unit will help produce benzene and toluene by saturating aromatic charge stocks by hydrogenation over platforming catalysts. This will permit subsequent extraction of the benzene and toluene. The third unit, an extraction unit, developed by the Dow Chemical Company, Midland, Michigan, is a single solvent, liquid contact type unit that will selectively extract aromatics of industrial grade from the aromatic stocks produced by the first two units.

The new platforming and catalytic units are being designed by the Universal Oil Products Company of Chicago and constructed by Procon, Incorporated. The extraction (UDEX) unit, developed by Dow, will also be constructed by Procon.

Although designed primarily for the production of benzene and toluene, the Roosevelt units are to be of sufficient capacity to permit processing of gasoline requirements as well as the benzene and toluene. To do this, according to Boudler, it is contemplated to run the platformer blocked out on benzene-toluene part time and on naphtha stock for motor gasoline, which will more than meet market requirements for the remaining time. The other units will run continuously. Design capacity of the platforming unit is 1750 bbl per stream day on gasoline operation or 1140 bbl per stream day on benzene-toluene operation. An auxiliary platformer will be included in the scheme.

Diesel Fuel Survey Out

Analytical data for 303 samples of 4 grades of diesel fuel highlight the report of the second national annual diesel-fuel survey conducted jointly by the Bureau of Mines and the American Petroleum Institute. The 1951 survey covers 37 more fuel samples than last year, and includes a number of designations of some samples for recommended use only in winter or summer. It also establishes new national marketing districts, based on supply systems, refinery locations, traffic arteries, etc., instead of employing the 1950 districts, which were based on motor-gasoline surveys. The samples represented the products of 49 manufacturers, 7 fewer than the number of refiners contributing data in 1950.

Samples of diesel fuel typical of actual shipments were taken during 1951 and analyzed according to accepted uniform procedures by the manufacturers of the fuels. Fourteen tests were applied to the samples, and the results were forwarded to the Bureau of Mines for study and compilation.

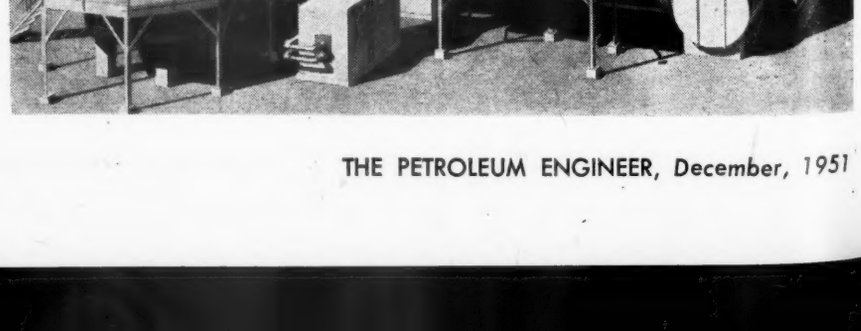
A free copy of Report of Investigations 4830, "National Annual Diesel-Fuel Survey, 1951," by O. C. Blade, Bureau petroleum chemist, may be obtained from the Bureau of Mines, Publications Distribution Section, 4800 Forbes Street, Pittsburgh 13, Pennsylvania.

Sulfur Recovery Plant Planned by Royalite

C. U. Daniels, president and managing director of Royalite Oil Company, Limited of Calgary, has announced that the company has placed an order with Foster-Wheeler Limited of Toronto for the fabrication of its sulfur recovery plant to be erected in Turner Valley, about 30 miles southwest of Calgary. Site for this $350,000 plant is adjacent to the present gas plant facilities at Turner Valley.

The plant is expected to be in operation in April 1952 and will recover elemental sulfur from the hydrogen sulfide removed from Turner Valley natural gas and at present vented into the atmosphere. Capacity of the plant will be around 30 long tons per day. During first year of operation it is expected that production will be approximately 9300 tons of sulfur.

Sulfur recovery plant to be erected for Royalite Oil Company, Ltd., Calgary, Canada.



Sinclair to Expand Its Houston Refinery

A $28,000,000 refinery expansion program for its Houston, Texas refinery by Sinclair Refining Company, to be completed late in 1953, will raise that plant's aviation fuel capacity to nearly twice the present output, according to announcement by P. C. Spencer, Sinclair president. The plant's capacity will be increased from 85,000 bbl per day to 110,000 bbl, it was stated, making this the largest of the seven Sinclair refineries and boosting the company's total capacity to about 385,000 bbl per day from its present 360,000 bbl. Capacity for butylenes for rubber production will be practically doubled, also.

The new system is built around a Fluid catalytic cracking unit to charge 40,000 bbl per day of gas oil. In addition to high octane number gasoline and butylenes for rubber, a heavy naphtha fraction will be produced that can be treated further catalytically to make gasoline and aromatics for aviation 115-145 fuel. Also a new 35,000 bbl crude unit will be built, along with 250,000 lb per hour of additional steam-making capacity; a primary vacuum tower will yield lubricating oil fraction; auxiliary units for water treating, electrical capacity expansion, and other needed items are included, the announcement stated.

New Chemical Weed Killer Can "Erase" Dense Growth

A new non-selective chemical weed killer that "erases" dense growths of mixed grasses and broad-leaf weeds, leaving only an expanse of bare soil, has been developed through Du Pont Company research, it was announced recently.

Known as CMU, short for 3-(p-chlorophenyl)-1,1-dimethylurea, the chemical has undergone extensive tests under a wide range of field conditions during the past year. In addition to Du Pont tests, more than 150 investigators have evaluated the compound in every state of the nation, as well as in Canada, Hawaii, Alaska, Puerto Rico, Honduras, and Colombia.

CMU is not flammable or corrosive. It is relatively non-volatile and has been applied as a spray, using a wettable powder dispersed in water. Laboratory tests have shown it to be extremely safe so far as toxic effects on warm-blooded animals are concerned.

Gulf to Have Largest Crude Distillation Unit

Foster Wheeler Corporation announced today receipt of a contract from Gulf Oil Corporation for the design, engineering, fabrication, and erection of a 125,000 bbl per stream day atmospheric and vacuum unit to be installed at Gulf's Philadelphia refinery. This unit, when completed in the summer of 1953, will be the largest single crude distillation unit ever constructed.

WESTON *Readable* ALL-METAL THERMOMETERS

—AVAILABLE IN THESE 3 TYPES

STANDARD INDUSTRIAL THERMOMETERS

All-metal dial types with stainless steel stems, in straight and angle forms. Scale lengths 3"—6" and 9", with stems from 2½" to 72". Available as testing thermometers, and for general purpose and heavy duty service. Ranges from −100 to +1000°F. All-metal construction prevents breakage, assures dependable accuracy for longer periods.

CONTACT MAKING THERMOMETERS

Combines the features of the all-metal indicating thermometer with an alarm or control device. Has adjustable contact arm mounted in the glass and bezel. Supplied to make contact on increasing or decreasing temperatures. Has positive magnetic type contacts. Contact rating . . . 100 ma at 110 volts a-c; 50 ma at 110 volts d-c. Stem lengths 2½" to 24".

MAX-MIN® THERMOMETERS

Equipped with a manually set red index which moves up or down scale with pointer, remaining at extreme temperature reached until reset. Thus one reading gives present temperature, and maximum or minimum reached since last reading. Available in scale lengths of 6" and 9"—stem lengths 2½" to 24".

Literature describing Weston all-metal, as well as electrical and glass thermometers, sent on request. WESTON Electrical Instrument Corporation, 617 Frelinghuysen Avenue, Newark 5, New Jersey . . . manufacturers of Weston and TAGliabue instruments.

WESTON *Instruments*

meet the new member of the family

model 21-401 mass spectrometer

an analytical and isotope-ratio mass spectrometer combined

CONSOLIDATED's new Model 21-401 Mass Spectrometer is a compact, medium-priced instrument, ideal for those laboratories having only moderate analytical loads. Highly versatile, it provides not only quantitative analyses of gaseous or light-liquid mixtures as automatically recorded mass spectra, but *also* precise *recorded* ratios of stable gaseous isotopes. Like the widely used Model 21-103, it is exceptionally accurate and incorporates many automatic, time-saving features. For the multitude of industrial and scientific applications not requiring extremes of mass range, sensitivity, and operating speed, the Model 21-401 is of maximum value. Further information is contained in Bulletin CEC-1821-X5.

The widely used Model 21-103 Mass Spectrometer for broad applications - analytical and research.

Model 21-201 Isotope-Ratio Mass Spectrometer - specifically for measuring ratios of stable isotopes in gases.

CONSOLIDATED ENGINEERING
Corporation

Analytical Instruments
300 No. Sierra Madre Villa
CEC
for Science and Industry
Pasadena 8, California

Shell Chemical Opens Sales Office in Atlanta

Shell Chemical Corporation has opened a new sales office in Atlanta, Georgia. M. W. Ellison, of the staff in New York, has been appointed manager of the new district. Ellison, new district manager, is a native of Montgomery, Alabama. With Shell Chemical since 1946, he is a graduate in chemistry from the University of Alabama. Aided by a staff of technically trained salesmen, Ellison will administer Shell Chemical sales activities in the states of Virginia, the Carolinas, Georgia, Florida, Alabama, and Tennessee.

Witco Chemical Moves

Witco Chemical Company, Limited, has moved from its old address at 101 Baker Street, London, W. 1, England, to larger and more centrally located offices in Bush House, Aldwych, London, W. C. 2, England, as a result of the expansion of its business. New telephone numbers are Temple Bar 6473, 6474, 6475, and 6476. The telegram addresses are Oxicolode, Estrand, London, and Wishtum, Estrand, London. Cables will reach the office when addressed to either Oxicolode or Wishtum, London.

Utah Oil to Begin $1,000,000 Expansion

Utah Oil Refining Company has announced that it has begun a $1,000,000 expansion program at its refinery in Salt Lake City, Utah. Six new gasoline and crude oil storage tanks with a capacity of 384,000 bbl will be installed and $120,000 worth of pipe lines to connect them to the refinery, according to E. S. Hold, president.

Also scheduled is conversion of an existing tank into a refrigerated container for storage of light distillates, erection of a steam boiler, and an expansion of water treatment facilities.

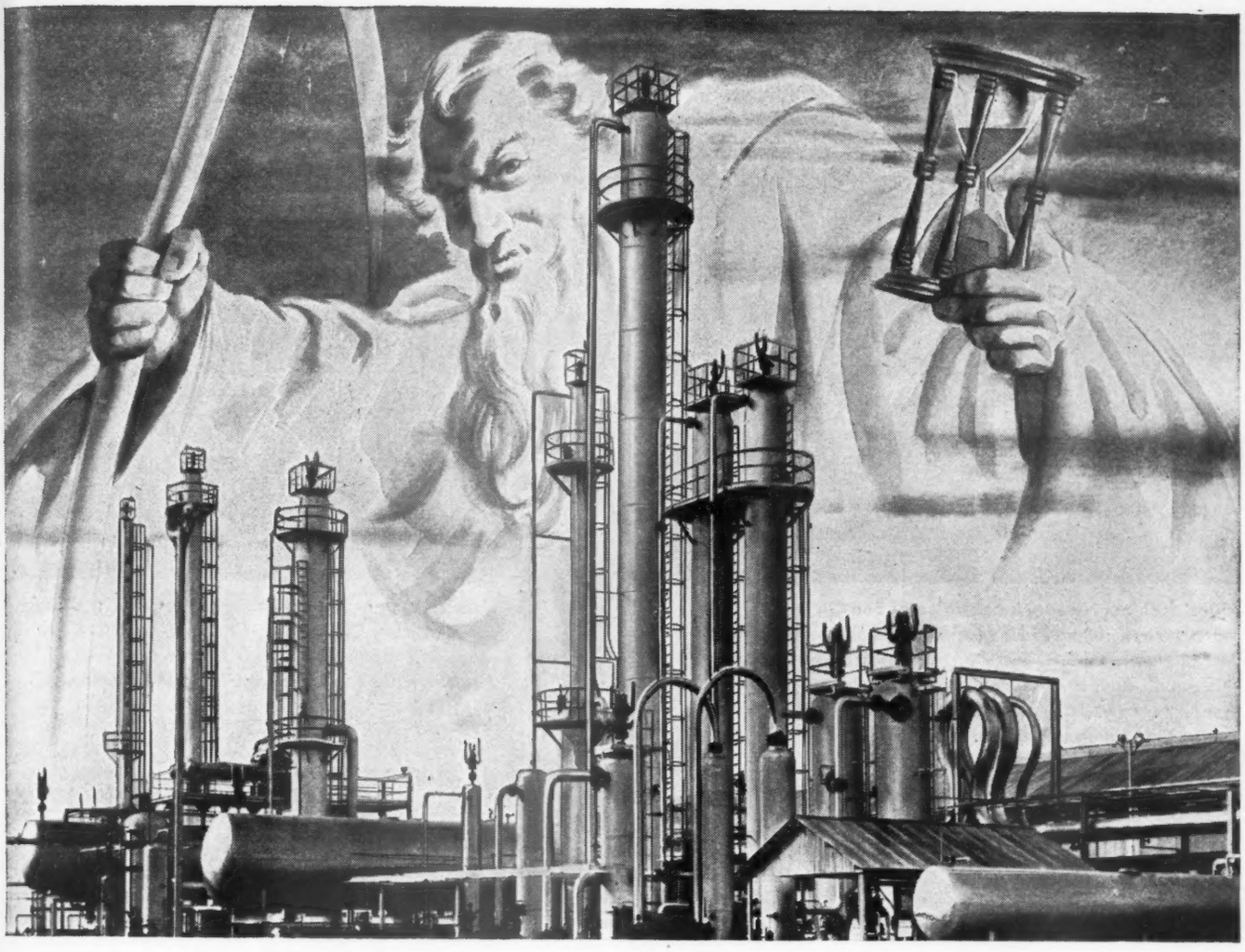
Northwestern Refinery Adds Two New Units

Northwestern Refining Company has announced plans for new catalytic cracking and gas recovery units in St. Paul Park, Minnesota. The new units are part of an extensive improvement and expansion program to increase Northwestern's crude processing capacity from 8000 to 30,000 bbl per day.

Authorization for construction work now in progress is covered by a certificate of necessity issued by the Defense Production Administration.

Company officials expect to receive similar authorization to increase their crude distillation facilities. Application has been made to construct a new 30,000 bbl per day skimming unit to augment present facilities and those now under construction, thus increasing refining capacity in the area at a considerable saving of critical steel.

Procon, Inc., construction subsidiary of Universal Oil Products Company, will construct the new plant.



Since 1929, A. O. Smith has been helping the petroleum, Petro-chemical, chemical and paper industries solve many of their difficult corrosion problems.

The Ultimate JUDGE is TIME

Smithlined vessels have been in continuous corrosive service for over 20 years without failure of the lining attachment or the vessel itself.

This history of service is significant. It confirms the findings of our own research laboratories and supports the designs of our engineers, that closely controlled resistance-welding of stainless or other corrosion resistant liners to carbon steel vessel walls is the best means of providing long-term service and satisfactory performance under specific corrosion, pressure and temperature conditions.

If you have a corrosion problem, let A. O. Smith work with you in solving it. Our engineers and laboratories have an unequalled background of experience and data gained from hundreds of successful applications of Smithlining. Contact our nearest district office.

A. O. Smith 77th ANNIVERSARY 1874 · 1951

A.O.Smith

VESSELS • HEAT EXCHANGERS

Boston 16 • Chicago 4 • Cleveland 15 • Dallas 2 • Denver 2
Houston 2 • Los Angeles 22 • Midland 5, Texas • New Orleans
New York 17 • Philadelphia 3 • Pittsburgh 19 • San Francisco 4
Seattle 1 • Tulsa 3 • Washington 6, D.C.

To obtain more information on products advertised see page E-51

At the 50th anniversary celebration of Sun Oil's Marcus Hook refinery, 50-year emblems were awarded to (left to right): John B. Marshall, J. Howard Pew, and William G. Rhyder. The men received emblems from Joseph N. Pew, Jr., chairman of the board, and Robert G. Dunlop, right, president.

E. O. Derrick, right, vice president and general manager of Mercury Oil Refining Company, and E. C. Hurd, refinery superintendent, study plans for the new $3,165,000 refinery the company is building in Oklahoma City.

Marcus Hook Refinery Notes 50th Anniversary

The history of Sun Oil Company's Marcus Hook refinery has been cited as an example of the progress that has been made by the petroleum industry operating in economic freedom.

Both Joseph N. Pew, Jr., chairman of the board, and Robert G. Dunlop, president, emphasized the resourcefulness exhibited by oil men over the years in meeting the needs of the nation's expanding economy at a dinner in Philadelphia, Pennsylvania, marking the 50th anniversary of the founding of the refinery. More than 6000 refinery employees and their guests attended.

One of the highlights of the program was the awarding of 50-year service emblems to three men who began work at the Marcus Hook refinery in 1901 and have been in continuous service with the company ever since. They are J. Howard Pew, former president and now a director, John B. Marshall, and William G. Rhyder. The latter two are refinery foremen.

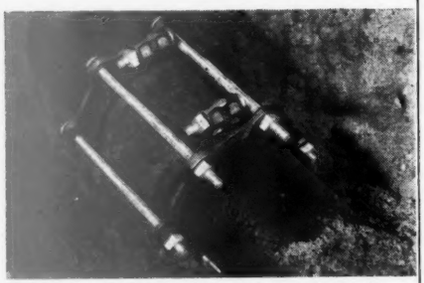
In his talk J. N. Pew, Jr., contrasted the operating conditions at the refinery in its early days with those of the present.

He pointed out that in 1902, the first year of operations, 200,000 bbl of crude oil were run through the refinery. In 1908 more than 1,000,000 bbl were run. This year, he added, the refinery will run 51,000,000 bbl—a 40-fold increase since 1908. The Marcus Hook refinery today has at least 120 times the capacity it had in 1908, Pew said. The average barrel of oil is processed more than 3 times for every one in those days.

Reviewing the history of Sun Oil, Dunlop attributed its success to its harmonious employee relations and the operating principles established by the founder.

REPAIR LEAKS
QUICKLY—PERMANENTLY

SKINNER-SEAL PIPE JOINT CLAMPS stop leaks at joints. Put on under pressure—without interruption of service. Quick, simple, lasting repair. Sizes 1/2" to 24" incl. in stock.



SKINNER-SEAL COLLAR LEAK CLAMP—designed to stop every type of collar leak in oil and gas lines. Sizes: 2" to 13" inclusive.

M. B. SKINNER COMPANY
SOUTH BEND 21, INDIANA, U. S. A.

Mercury Oil to Enlarge Oklahoma City Refinery

A $3,195,000 expansion of the Mercury Oil Refining Company facilities, which will increase capacity of the Oklahoma City plant from 3150 bbl to 10,000 bbl daily has been announced by E. O. Derrick, vice president and general manager.

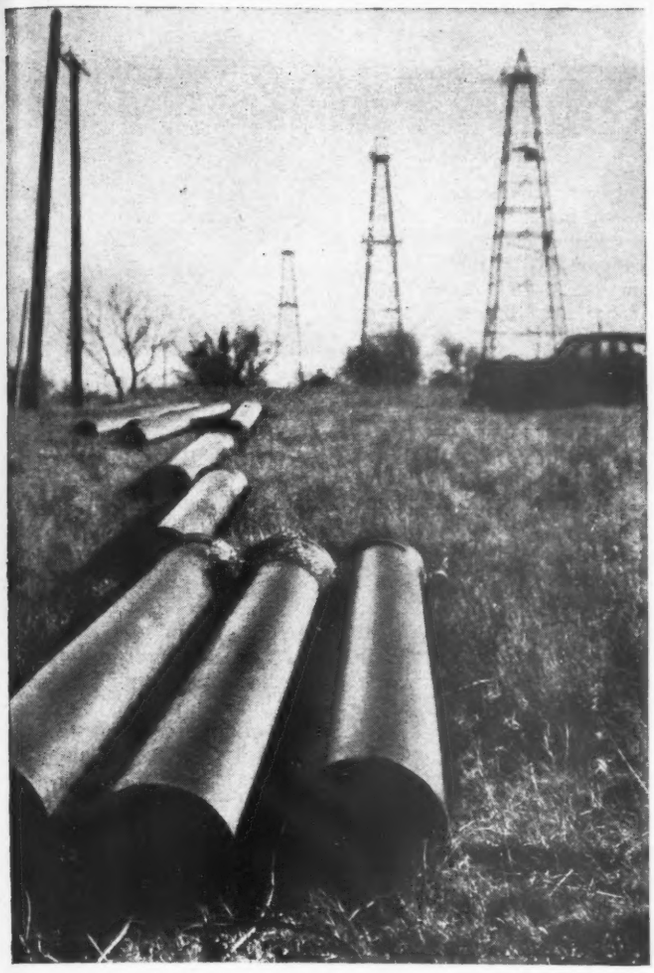
The expansion program will include construction of a new Fluid catalytic cracking plant, a gas concentration and polymerization plant and all necessary auxiliary equipment. Mercury celebrated its tenth anniversary in Oklahoma City in September. President of the company is W. E. Anderson, Muskegon, Michigan, who is also president of Naph-Sol Refining Company of Muskegon.

It is expected that construction of the new plant will be completed before October 1952. The plant will be built by Refinery Engineering Company of Tulsa. Construction has already begun.

The new facilities will be geared to the production of high octane aviation gasoline and jet engine fuel. At the present time the plant is engaged in producing more than 1,000,000 gal of various petroleum products for defense purposes during the remainder of this year.

During its 10 years of operation Mercury has produced premium ethyl and regular gasoline, furnace oil, diesel fuel, and residual oil. The expanded facilities will triple production.

Storage capacity of the refinery will also be increased by 565,000 bbl. The refinery now is served by major pipe lines running through the Oklahoma City area.



AN OLDTIME RECIPE FOR LONG-LIVED PIPE LINES

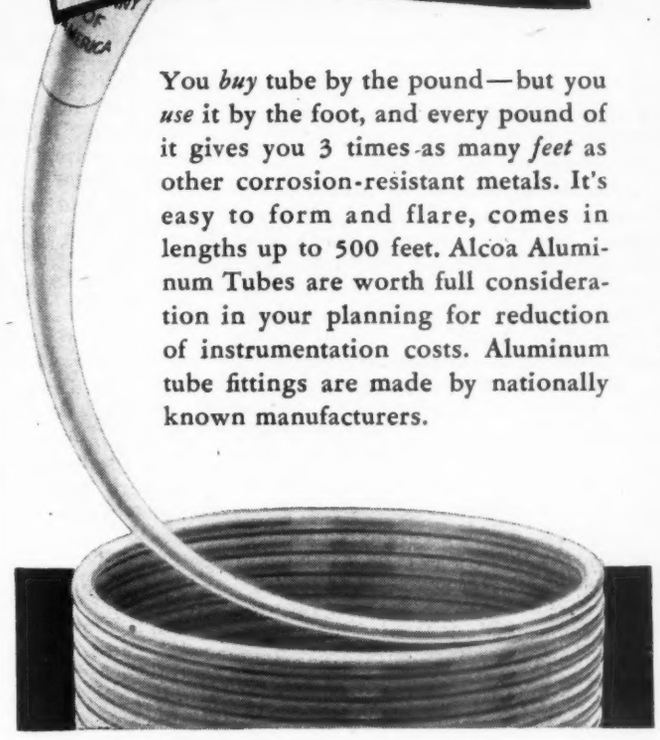
A recipe that waterworks and gas distribution engineers have used for over a century is: *specify cast iron pipe.* Refinery engineers have used it, too—with good success—for run-down, water and gasoline lines—for fire protection systems—salt water disposal—condenser and cooling coils.

No other pipe, at reasonable first cost, offers comparable resistance to both interior and exterior corrosion. No other pipe, in its price range, is as economical in the end. Available with bell-and-spigot, plain end and flanged, or with standardized mechanical joints. Cast Iron Pipe Research Association, Thomas F. Wolfe, Engineer, 1015 Peoples Gas Bldg., Chicago 3, Illinois.

CAST IRON PIPE
FOR LONG LIFE AND ECONOMY

Figure tubing installations *by the Foot...*

You'll find ALUMINUM goes 3 times farther



You *buy* tube by the pound—but you *use* it by the foot, and every pound of it gives you 3 times as many *feet* as other corrosion-resistant metals. It's easy to form and flare, comes in lengths up to 500 feet. Alcoa Aluminum Tubes are worth full consideration in your planning for reduction of instrumentation costs. Aluminum tube fittings are made by nationally known manufacturers.

DUE TO REARMAMENT aluminum is not available for unrestricted industrial use. However, when tubing is used, extensive engineering and planning are often required. This advertisement is intended as an aid to your planning.

For facts on aluminum tubes, write for Alcoa's booklet, "Instrument Lines of Alcoa Aluminum"—illustrated, crammed with facts! Address, ALUMINUM COMPANY OF AMERICA, 839M Gulf Building, Pittsburgh 19, Penna.

ALCOA *Coiled Tubes* **ALUMINUM**

—PERSONALS—

Erwin Di Cyan, consulting chemist, Di Cyan and Brown, has been elected president of the Association of Consulting Chemists and Chemical Engineers, Inc. Other officers include, vice president, **Earl D. Stewart,** director of research, Schwarz Labs, Inc.; secretary, **William C. Bowden, Jr.,** technical director, Ledoux and Company, Inc.; treasurer, **Foster Dee Snell,** president, Foster D. Snell, Inc.

In addition to the hold-over councilors the following were elected for three years each: **Robert S. Aries,** Robert S. Aries and Associates; **Elliott A. Haller,** vice president, The Haller Testing Labs, Inc.; **Hugh Klein,** consulting chemical engineer, C. E. Mange Development Lab; **Robert V. Siebel,** president Siebel Central Laboratories, Inc.

Dr. Bernard Lewis, internationally known physical chemist who is chief of the explosives and physical sciences division of the Bureau of Mines Northeastern region at Pittsburgh, Pennsylvania, has been granted a year's leave of absence to become director of powder and explosives research and development for the Ordnance Corps, Department of the Army, Secretary of the Interior Oscar L. Chapman announced.

Thomas H. Miller, acting director of the Bureau of Mines, said that **Dr. Glenn H. Damon** will be acting chief of the division during Dr. Lewis' absence.

Widely known for his research on combustion, flame, explosion of gases, explosives, and mine safety developments, Dr. Lewis served as a lieutenant colonel in the Army Ordnance Corps during World War II. He was awarded the Legion of Merit for developing and supervising manufacture of a new type grenade fuse credited with saving the lives of thousands of United States soldiers.

Dr. Frederick E. Frey, assistant director of research of the Phillips Petroleum Company, Bartlesville, Oklahoma, has been elected chairman of the American Chemical Society's Division of Petroleum Chemistry for 1952. He succeeds **Dr. Bernard H. Shoemaker,** assistant director of research of the Standard Oil Company of Indiana, Whiting, Indiana.

A. L. Lyman, director of the Richmond, California, laboratories of the California Research Corporation, was chosen chairman-elect, and Dr. Warren F. Faragher, technical adviser to the vice president in charge of research, Houdry Process Corporation, Marcus Hook, Pennsylvania, was named secretary-treasurer.

Dr. Frey is recognized as one of the outstanding petroleum chemists in the country. In 1949 he received the Southwest Award, given annually by local sections of the American Chemical Society in the Southwest, for his outstanding contributions to the chemical profession. He was graduated from the College of Wooster in 1922, and received the Master of Science degree from the Ohio State University in 1924 and the honorary Doctor of Science degree from Wooster in 1948.

Dr. John F. Foster, supervisor of fuels research at the Battelle Memorial Institute, Columbus, Ohio, has been elected chairman of the American Chemical Society's Division of Gas and Fuel Chemistry for 1952. He will succeed **Dr. Arthur A. Orning** of the Carnegie Institute of Technology.

George D. Creelman, research director of the M. A. Hanna Company, Cleveland, was chosen chairman-elect, and **Dr. Harlan W. Nelson,** also a supervisor of fuels research at the Battelle Memorial Institute, was named secretary-treasurer.

Dr. Foster was born in Toledo, Ohio, in 1902 and was graduated from Ohio Wesleyan University with the B.A. degree in 1931. He received the M. S. degree from Syracuse University in 1932 and the Ph. D. from Stanford University in 1935.

Samuel Kahn has recently joined the technical staff of Witco Chemical Company's research laboratory in Chicago as a group leader. Kahn obtained his master's degree at M. I. T. in 1947 and comes to Witco from Godfrey L. Cabot, Inc.

Dr. Raymond E. Schaad has been appointed to the position of technical adviser to Col. J. C. Raaen, manager of Universal Oil Product's research and development laboratories at Riverside, Illinois.

Dr. Schaad, who recently completed 25 years of research, patent, and development work with Universal, is a member of the American Chemical Society, a registered patent agent, and a registered professional engineer of Illinois. He is a graduate of Denison University and received his PhD degree in chemistry from Ohio State University.

Charles E. Maschal, manager of Sun Oil Company's Marcus Hook refinery, was one of 60 alumni of Drexel Institute of Technology who were awarded citations for their civic contributions and professional accomplishments recently at a three-day convocation celebrating the 60th anniversary of the founding of Drexel Institute.

Maschal, who received his B.S. degree in civil engineering in 1931, was cited by the Institute for civic and industrial leadership.

Howard A. Parker, Jr.

Howard A. Parker, Jr., formerly of the research department of Standard of Indiana has been named technical director of Pan-Am Southern Corporation's Destrehan refinery. Parker, who was group leader in charge of process design for the Indiana Company fills a key position in the Destrehan plant now being expanded at a cost of several million dollars to bring it's crude-running capacity up to 30,000 bbl a day.

Parker holds BS and MS degrees from Cornell University. He joined Standard of Indiana in 1944 as a process design engineer and two years later became the group leader. He is a member of Tau Beta Pi and a member of the American Institute of Chemical Engineers.

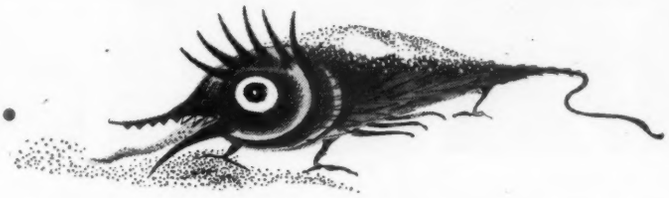
F. M. Simpson has been elected president of Cit-Con Oil Corporation of Lake Charles, Louisiana. Simpson succeeds **Burl S. Watson,** who becomes chairman of the executive committee. Simpson has been vice president and general manager of Cit-Con since its organization in 1947. Jointly owned by Cities Service Company and Continental Oil Company, Cit-Con is one of the largest lubricating oil plants in the country, with an output in excess of 8000 bbl daily.

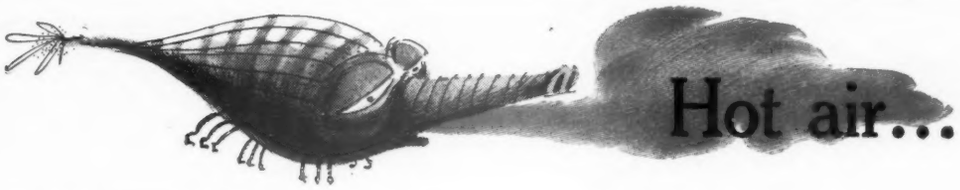
Simpson joined Cities Service Oil Company upon his graduation from Texas A and M College, and held various key positions in the Cities Service organization prior to his association with Cit-Con.

H. L. Barnebey, formerly promotion manager and chlor-alkali department manager for the Blaw-Knox Construction Company, has established his own business in Pittsburgh (P.O. Box 144), Pennsylvania, for the selection, evaluation, and licensing of important chemical and petroleum processes. His service to the industry includes: The location and selection of a process to answer a specific requirement and arrangement for its use on a commercially attractive basis; the evaluation of a process for a particular purpose or in comparison with other methods to establish its present and future worth, and the promotion to industry on a royalty basis of chemical processes that have proved their worth by successful pilot plant operation or commercial use.

Corrosive fumes...

Salt air...





Hot air...

Moist air...

SO WHAT!

"KARBATE" BRAND *impervious graphite pipe takes it all in stride!*

Have you thought about corrosion *on the outside* of your plant piping? Fumes, salt air, hot air, moist air, can eat up *the exterior* of piping, fittings, valves, pumps, and other equipment around a chemical plant And it costs money to protect ordinary metal surfaces. You have to sandblast, use special coatings, and even then you find the corrosion creeping in and chewing up the equipment...

NOT SO WITH "KARBATE" IMPERVIOUS GRAPHITE!

Here are the advantages:

- **No exterior protection needed**
- **Both acid-resistant and alkali-resistant**
- **Light in weight, easy to machine and assemble**
- **No metallic contamination of product**
- **Immune to thermal shock**
- **Very high thermal conductivity**

The term "Karbate" is a registered trade-mark of Union Carbide and Carbon Corporation

NATIONAL CARBON COMPANY
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N. Y.
District Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco
IN CANADA: National Carbon Limited
Montreal, Toronto, Winnipeg

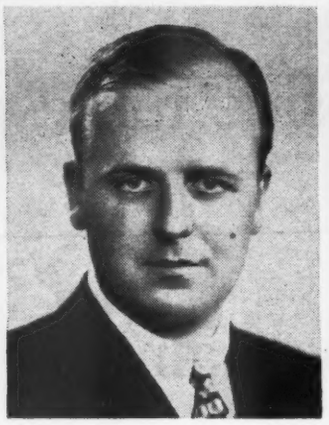
Other NATIONAL CARBON Products

HEAT EXCHANGERS • PUMPS • VALVES • PIPING • TOWERS • TOWER PACKING • BUBBLE CAPS • BRICK • STRUCTURAL CARBON • SULPHURIC ACID CUTTERS • HYDROCHLORIC ACID ABSORBERS

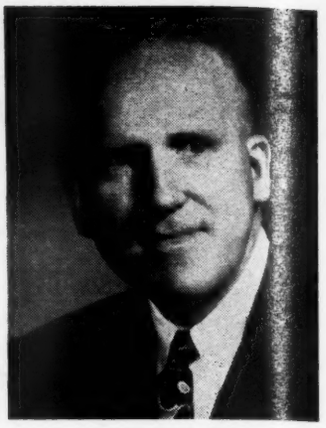
To obtain more information on products advertised see page E-51

M. G. Geiger

R. L. Hockley



J. P. Grace, Jr.



J. T. Wolfe

M. G. Geiger was appointed to the position of vice chairman of the board of Davison Chemical Corporation recently. The newly created post is being filled by the former executive vice president. **R. L. Hockley**, was elected to succeed Geiger.

Also approved was authorization to increase the number of Davison directors from 11 to 15. **J. Peter Grace, Jr.**, president of W. R. Grace and Company, New York City, was elected to one of the vacancies. He is director of Grace Lines, Inc., National City Bank, Ingersoll Rand Company, Northern Insurance Company, Assurance Company of America, and Stone and Webster, Inc., and a trustee of Atlantic Mutual Insurance Company, Centennial Insurance Company, and Emigrant Industrial Savings Bank.

J. Theodore Wolfe was elected a director to fill the vacancy caused by the death of E. J. Quintal. Wolfe is executive vice president of the Consolidated Gas Electric Light and Power Company of Baltimore and a director of that company and of the Provident Savings Bank and the Maryland Trust Company, both of Baltimore.

Judd W. Healy, chemical engineer in the Standard Oil Company (Indiana) research laboratory at Whiting, Indiana, has been promoted to group leader at the company's Wood River, Illinois, laboratory. Healy joined Standard in 1947. He did his undergraduate work at Pennsylvania State College and received his master of science degree from Massachusetts Institute of Technology.

Irving E. Miller, chemical engineer in the Standard research laboratory at Sugar Creek, Missouri, also has been promoted to group leader. Miller joined Standard in 1944. He is a graduate of the University of Kansas.

Dr. W. E. Bradley, assistant to the vice president, Union Oil Company of California, has been named manager of research. **Homer Reed,** chief engineer for manufacturing, will be chief engineer in charge of engineering and development.

R. J. Garofalo, Union Oil assistant patent counsel, becomes patent counsel.

J. E. Sherborne, formerly assistant to the vice president, will be assistant manager of research.

Dr. Clyde Berg, assistant to the vice president, has been named manager of process development, with headquarters at Union Oil of California's Los Angeles refinery.

Arnold Kelley was named supervisor of manufacturing processes, with headquarters at the Los Angeles office. **Jack Tielrooy** will be supervisor of chemical processes at Brea, and **Paul Foreman,** supervisor of process economics at Brea.

Ernest G. Holzmann has recently joined the Shell Development staff, at Emeryville, California. He is a graduate of University College of Nottingham, England, and comes to Shell from Massachusetts Institute of Technology, where he was a research assistant in acoustics, and recently received the M.S. degree for his thesis on "Optimum Response in Relay Servomechanisms."

William B. Humble, who has been active in power engineering and consultant work in the San Francisco area, joined the staff of Shell Development as electrical engineer. Humble holds an E.E. degree from the University of British Columbia.

Miss Mary Neal, a graduate of Northwestern University, has joined the company's staff as analytical chemist. Miss Neal was on the staff of Northwestern as research assistant in biochemistry before coming to Shell.

Other personnel additions to the Shell Development staff at Emeryville include: Chemical engineers **Lloyd F. Freechtle,** M.S. at University of California this June; **Richard W. Kunstman,** University of Illinois, Ph.D candidate, and **Harry A. Wistrich, Jr.,** recent Ph.D from Cornell.

Wayne E. Pearson, recently graduated from the University of Delaware with an M.S. in physical chemistry, has been named to the research staff of electro chemicals department of Du Pont Company, at Niagara Falls. **Edward E. Hamel,** from University of Southern California, has also been appointed as a member of the research staff.

Richard L. Demmerle has resigned as executive editor of "Chemical Week" to become assistant director of administration of General Aniline and Film Corporation. Demmerle is a chemistry graduate of Columbia University where he also did graduate work in chemical engineering. He was administrative officer to the director of research, Manhattan Project Laboratories.

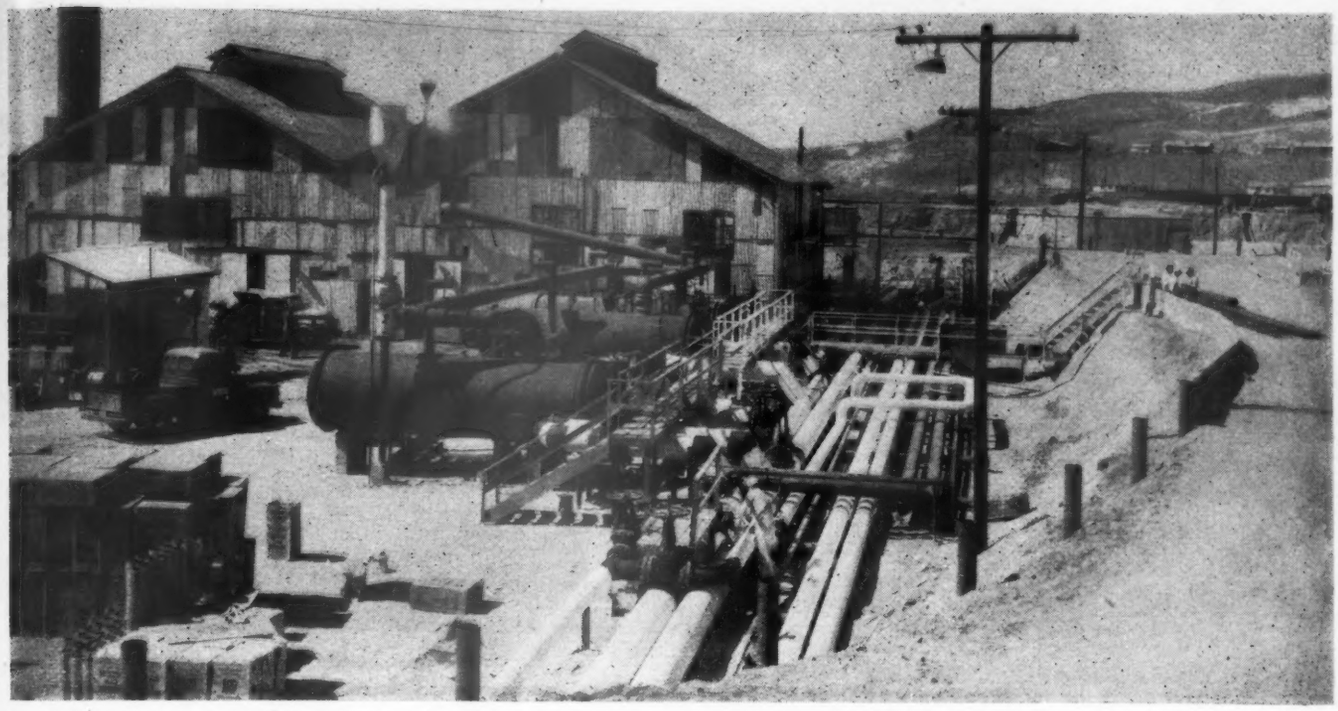
He became associate editor of "Chemical Engineering News" and "Industrial and Engineering Chemistry" in 1945, and left these American Chemical Society publications to join McGraw-Hill as executive editor of "Chemical Week" in 1950.

S. C. Harper has been named assistant manager of the Arabian American Oil Company's manufacturing and supply department in New York City. Harper is former staff manager of refining for Arabian American Oil Company at Dharan, Saudi Arabia.

William B. Hayes has been named head of production research in the research department of Stauffer Chemical Company. **Miroslav Pistek** was named to production research section at Niagara Falls. Other research staff additions include: **William Urbowicz** from National Lead Company and **Joseph Linnett,** formerly with Marcus-Ruth-Jerome Company have been added to the process development section at Chauncey, New York, and **Alexander Porianda,** formerly with National Adhesive and Starch is in the chemical research department at Chauncey.

Arthur A. Lynch has been named director of process development for Pittsburgh Coke and Chemical Company. He was formerly assistant director of chemical engineering at American Cyanamid Company, Stamford.

Thomas S. Nichols, chairman and president of Mathieson Chemical Corporation has been elected to the board of American Potash and Chemical Corporation. Others named to the board are: **John C. Leppart,** executive vice president; **Sinclair Richardson, Robert G. Stone,** and **Gardiner Symonds,** director of Mathieson.



Crude from the San Ardo fields is gathered at the San Ardo pump station where three large black cylinders (foreground, before magnesia insulation installed) serve as heat exchangers. Entire station buildings were reclaimed from the old pipe line installation.

Blending and Heat Solve Heavy Oil Problem

A drilling boom has been touched off in an almost lifeless field thanks to ingenuity with a pipe line

WILLIAM T. RINTOUL

ECONOMIC development of an oil field often hangs on a slender thread, and, in the case of one California field, that thread happens to be a 40-mile pipe line embodying some unique and interesting engineering features.

For three years after the discovery of oil at San Ardo in November, 1947, one major obstacle persistently blocked any appreciable development of the newfound field.

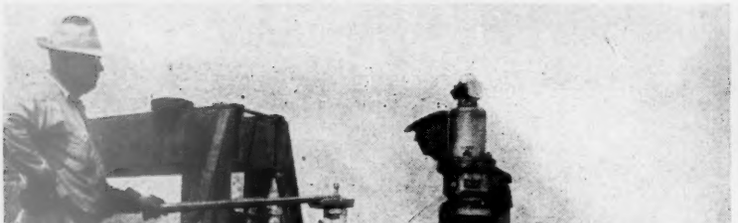
There was no economical means of transporting the heavy and highly viscous crude oil to refineries from San Ardo, which is situated in the southern end of Salinas Valley about 250 miles north of Los Angeles.

Despite the fact that the field was generally recognized as the second largest heavy crude reservoir in California, field production as recently as August, 1950, averaged less than 400 bbl a day.

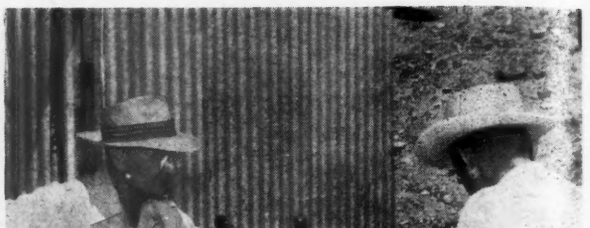
It took a company without a single

EXCLUSIVE

A section of the pipe line before being coated and lowered-in.



Each double length of pipe was hydrostatically tested before being certified for use in the San Ardo-Estero Bay pipe line.



Ralph Gardiner (left) General Petroleum machinist foreman, and the "ghizmo" developed to handle the field blending operation. The device permits "cutter stock" to be fed into the suction side of pump at the same time as crude oil. Proportions can be accurately controlled by turning the handle under Gardiner's hand.

producing well at San Ardo to solve the lifeless field's transport problem and thereby touch off a long-delayed drilling boom.

Several months ago General Petroleum Corporation completed a $2,000,000 pipe line from San Ardo to Estero Bay on the Pacific Ocean to underwrite full development of the San Ardo field, which now seems destined to take its place among the major fields of California.

Current high military requirements in the West provided a stimulus for General Petroleum Corporation to lay the 40-mile, 8-in. pipe line, according to George Supple, G.P.'s vice president and director of pipe lines.

Another important factor in bringing the pipe line to San Ardo was the increasingly brighter outlook in the heavy crude price pattern. After several years of playing second fiddle to lighter oil, the low gravity crude has come back into its own in the overall oil picture and gives every indication of being back to stay.

Low gravity of the San Ardo crude necessitated some unusual engineering features in General Petroleum's pipe line. Two basic crudes make up San Ardo production. The first, which is by far the greater in volume, is from the Lombardi zone. It has a gravity of 11.8 deg and a viscosity of 1021 seconds (Saybolt furol) at 122 F. The second crude is from the Aurignac zone. It has a gravity of 13.4 deg and a viscosity of 369 sec (Saybolt furol) at 122 F.

Sticky San Ardo crude, heretofore impossible to move by ordinary pipe lines, has been made to flow by the use of two devices.

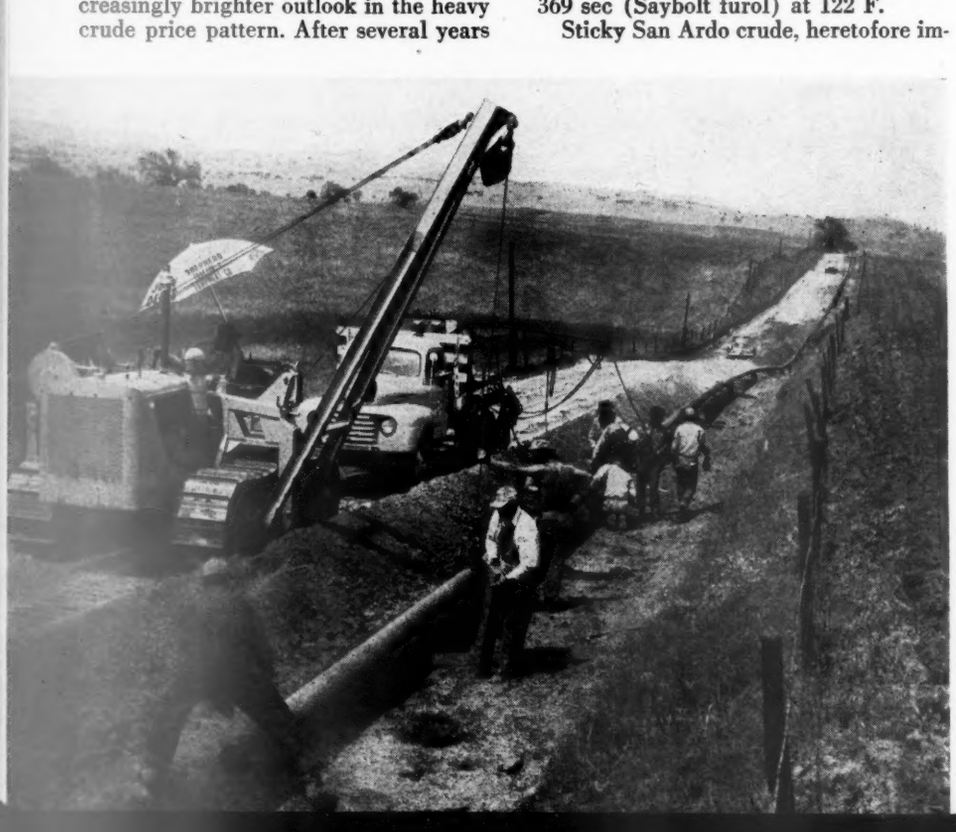
First, the oil is blended with "cutter stock," a light petroleum product brought to the field for that purpose; and second, it is heated to over 170 F for the trip through the pipe line.

Use of "cutter stock", a middle distillate, had been tried before with oil wells but never extensively in pipe lines.

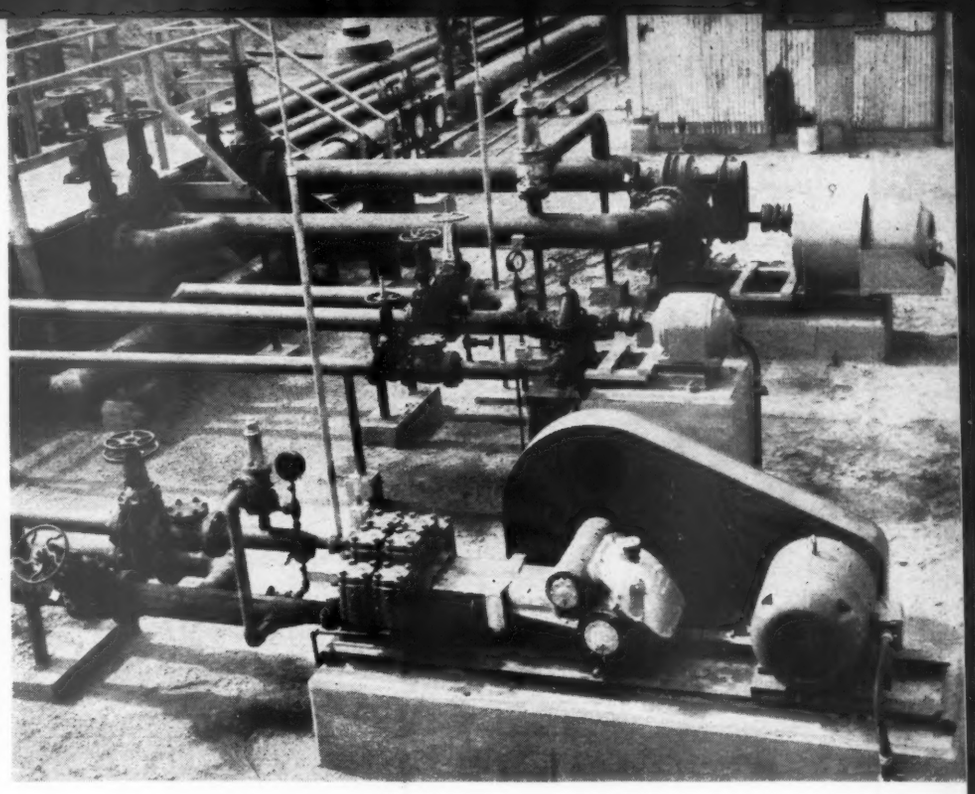
This stock consists of 31-deg gravity virgin gas oil, brought to the San Ardo station in a 4-in. pipe line, which lies in the same ditch as the 8-in. line. General Petroleum is blending in about 16 per cent "cutter stock" at present, though this may change under winter operating conditions. The final blend of San Ardo crude oil and "cutter stock" has a gravity of 14.4 deg and a viscosity of 170 sec (Saybolt furol) at 122 F.

Blending takes place partially at the field gathering tanks, partially in a special blending tank, and partially as the blend actually passes through the main line pump.

To handle the field blending operation, General Petroleum machinist foreman, Ralph Gardiner, and his crew de-



Reconditioned pipe was laid by boom-type tractors. It is now a fully welded line. The picture above shows one of the few easy stretches of country encountered on the 40-mile route.



This battery of three pumps does the blending of "cutter stock" and crude oil. The pump in the background circulates crude oil in and out of a huge 55,000-bbl blending tank. The small pump in the center pushes the cutter stock into the crude oil as it goes into blending tank. The pump in the foreground—one of the few new items used on the whole San Ardo project—pushes cutter stock out to a dozen spots in the oil fields through a network of small pipes.

veloped an interesting "ghizmo." It is a valve-like device installed on the suction chamber of a duplex pump. The device permits "cutter stock" to be fed into the suction side of the pump at the same time as crude oil. The proportions can be accurately controlled by turning a handle on top of the device. The pumping piston does the mixing.

Only a minimum amount of "cutter stock" is mixed in at the field tank sites to permit a maximum amount of crude oil to be moved through the available gathering system.

A battery of three pumps, two of which were salvaged from previous General Petroleum installations and rebuilt for their new jobs at San Ardo, do the blending of "cutter stock" and crude oil.

The first pump circulates the crude oil in and out of a huge, 55,000-bbl blending tank. The second pump pushes the "cutter stock" into the crude oil as it goes into the blending tank. The third pump shows how even the best idea can be made better by pushing "cutter stock" out to a dozen spots in the oil fields through a network of small pipes.

Three large heat exchangers, insulated with magnesia, are used to heat the mixture at the San Ardo pump station, where the crude oil is gathered. As the viscous crude is blended with "cutter stock," the first heat exchanger gradually increases the temperature of the mixture.

The other two heat the blend before the main line pumps push it into the 8-in. pipe line. Two intermediate stations heat the blend only, with all of the mixing being done at the San Ardo station.

When the "flow-ability" of the San Ardo crude oil has been improved enough by blending and heating, it is pumped to a marine loading plant at Estero Bay to be taken away by tankers. General Petroleum Corporation leases from Standard Oil Company of California the privilege to use loading facilities at Estero Bay, which has long been a Standard shipping point.

Capacity of the pipe line is rated at between 18,500 and 20,000 bbl daily of blended oil. Present production at San Ardo is almost 9000 bbl a day and all this output is being handled by the G. P. pipe line.

Contractor for the pipe line work was Bechtel Corporation. Under terms of the contract, Bechtel took up General Petroleum's old Mojave line and reinstalled it at San Ardo.

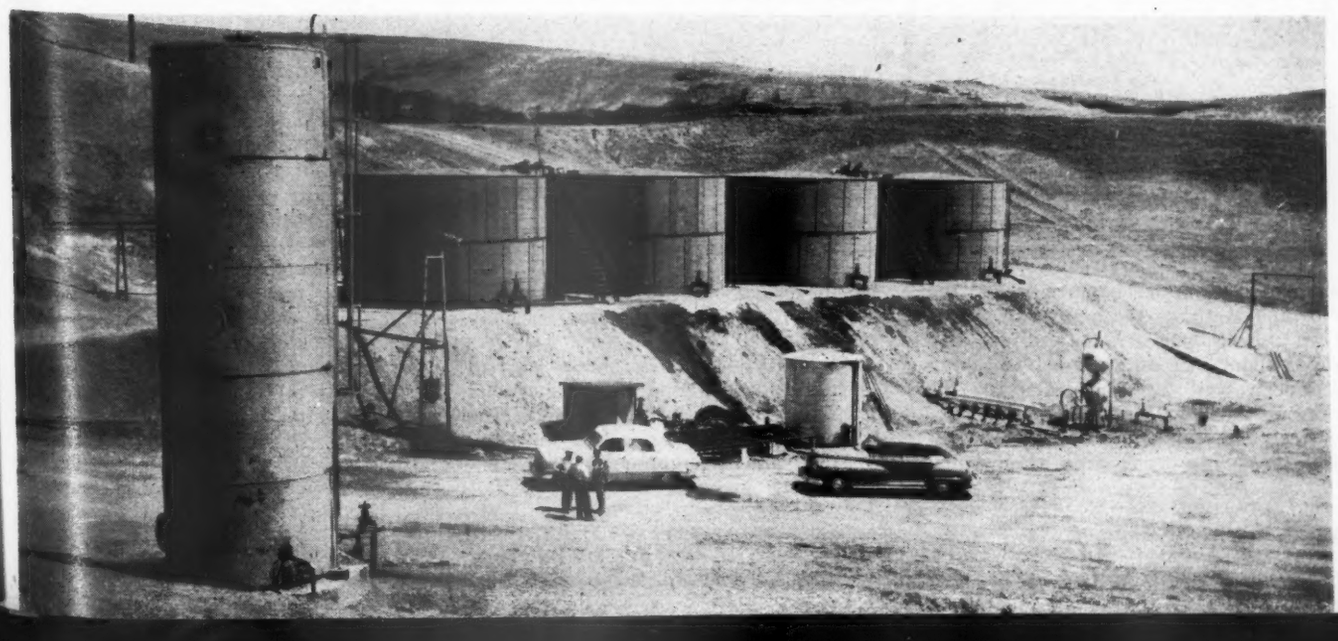
Originally laid in 1913 to connect General Petroleum Corporation's Lebec refinery in the Tehachapi Mountains with the Mojave refueling station of the Santa Fe railway, the old pipe was rendered obsolete by the shift of Santa Fe's engines from steam to deisel.

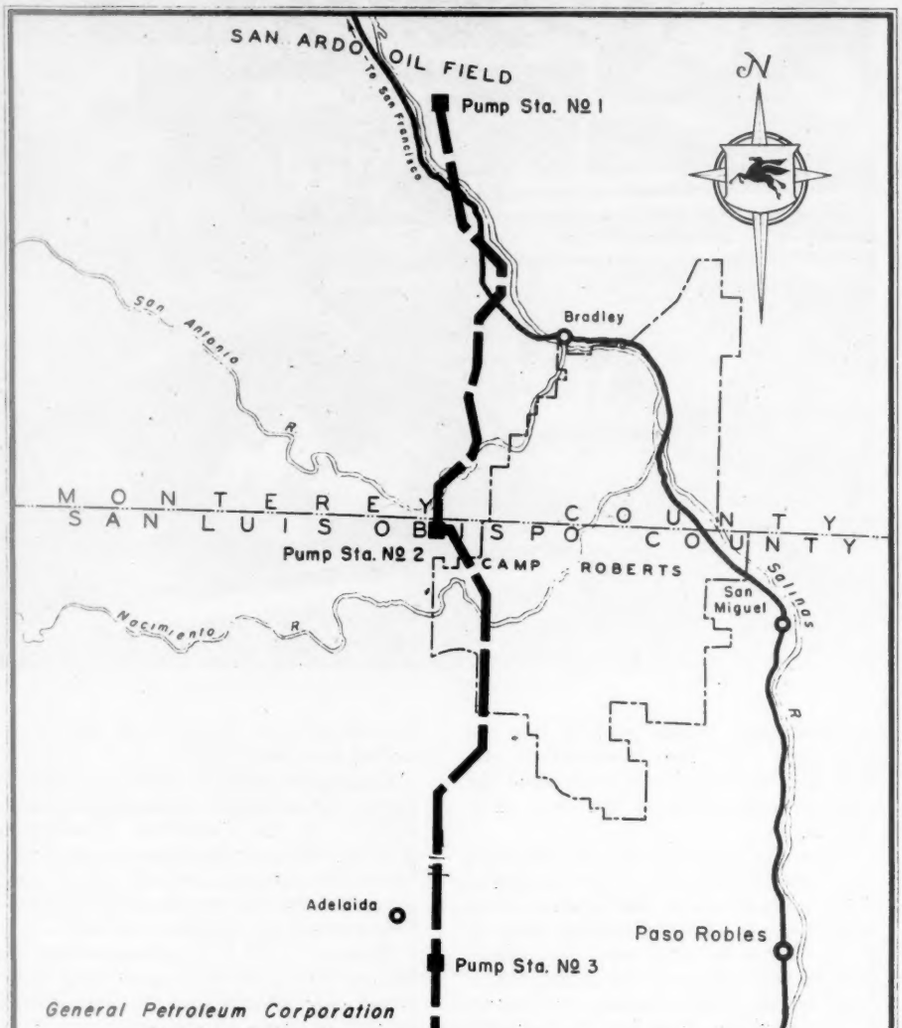
During its 38 years of operation to Mojave, the pipe line carried an estimated 133,000,000 bbl of fuel oil—enough to drive all the steam-powered trains in the nation for a full year.

When Bechtel Corporation's crews raised the old line, they found it to be in surprisingly good condition, considering its long tour of duty on the Lebec-Mojave run. Dry, sandy soil of the Mojave Desert proved to be a much better preservative for the pipe than its counterparts in the southern San Joaquin Valley oil fields.

Prior to the salvage job, engineers

This battery of crude oil field tanks is connected to the San Ardo station by a conventional gathering system. Added to the system have been facilities for blending a certain amount of "cutter stock" in the field. Cutter stock is stored in the tall tank in the left foreground, reclaimed from a marketing bulk plant.





estimated a 98 per cent re-use of the old pipe. Actually the figure ran higher than this. Salvage of the Mojave line saved about 2650 tons of steel—a saving that can well be appreciated in the present shortage of steel.

Acetylene torches were used to cut collars of this crude pipe after which it was loaded onto flat bed trucks and hauled to San Miguel for reconditioning.

At a "factory in the field" at San Miguel, salvaged pipe was cleaned and prepared for welding. Lengths of pipe were burned clean inside and out, shot-blasted, and straightened. Remaining collars and threads were cut off and scarfed. Finally two lengths were welded together and each double length hydrostatically tested. Reconditioned pipe was laid by boom-type tractors as a fully welded line.

Three steam-powered pumping stations, salvaged from the old Mojave line, and one electric pumping station, were erected at intervals along the 40-mile route of the pipe line. Corliss pumps, used in the Mojave line, were transported to San Ardo for new use there. A 150-hp electric motor provides the power for the small electric pump station.

Typical of the reclaimed equipment from the Lebec-Mojave line that is now serving at San Ardo is a Jeansville steam pump from the old Lebec pipe line station. It was reconditioned and General Petroleum engineers feel it might well have another four decades of service in it.

In all, the list of salvaged equipment reads like this: 22 tanks, 16 heat exchangers, 6 boilers, 3 stacks, 41 pumps, and 3 station buildings.

Seven huge tanks with a total capacity of 283,000 bbl were erected to handle the crude oil, blending stock, and blended oil. Originally riveted together, the tanks were moved piecemeal by cutting the sheets between riveted edges.

Bechtel Corporation crews spent approximately three months in taking up the Mojave line and reinstalling it in sections along the San Ardo-Estero Bay route.

Completion of the pipe line has, during the last three months, provided a shot-in-the-arm for the San Ardo field.

The Texas Company drilled the San Ardo discovery well, Lombardi No. 1 on Sec. 27, 22-10, completing it in November, 1947, for 155 bbl a day on the pump. Gravity of the oil was about 11 deg. The discovery well was produced for two days and then shut in.

Additional drilling by The Texas Company, Jergins Oil Company, North American Oil Consolidated (owned by General American Oil Company), and Superior Oil Company proved up almost 1000 acres in three separate structures in the field.

Development of the field ceased during June, 1949, although a large number of interior locations remained to be drilled. Low prices for heavy crude and the transport problem proved responsible for the halt in drilling activity.

The field is still well under 50 per cent developed and there is a good possibility that additional wildcatting will substantially expand the field limits.

Today, with prospects of getting the San Ardo crude to markets with some measure of economy, operators in the field are planning ambitious drilling campaigns. The Texas Company alone has a backlog of 33 proved locations slated for early drilling at San Ardo.

Thanks to General Petroleum's $2,000,000 pipe line, it looks at though business will be good for some time to come at San Ardo. ★ ★ ★

COMPUTING GAS PIPE LINES

Application to pipe lines of an improved method of representing wide-range scales in alignment diagram.

J. F. VOORWIJK

The Author

The author qualified in mechanical engineering at the Technical High School Amsterdam and was active for a number of years in the cane sugar industry of Java. During this period he published several nomograms in a sugar manufacturer's journal ("Archief voor de Suikerindustrie in Ned. Indië"). In 1937 he joined the Bataafsche Petroleum Maatschappij (Royal Dutch Shell Group), where he is engaged in the development of graphical computation methods for work design.

IN THE construction of nomographs composed of a number of parallel logarithmic scales we are sometimes confronted with the difficulty that one or more quantities are variable over a wide range, say from 1 to 10^n. If the entire range should be covered in one diagram, a large number of logarithmic cycles would be required. It will be obvious that the length of one logarithmic cycle (= scale modulus) would become small for a drawing sheet of not too large dimensions, with the result that the readings of such scales could not be very accurate. It is possible, however, to construct the nomograph in such a way that only one logarithmic cycle ranging from 1 to 10 is used for the wide-range scales. Thus the accuracy of their readings is greatly increased. Each value, variable over a wide range, can be written as a product of a number between 1 and 10 and a power of 10. For complicated formulas we have to incorporate the exponent of 10 at the outset of the problem before we can start with the nomograph. This device yields a significant and notable increase of accuracy of the whole alignment chart, even in compact form as displayed in the accompanying nomograph. It will be worth while recording this nomographic innovation.

The above method can be best explained by means of an example. For the design of "Horizontal Gas Pipe Lines" the following formula is often used, viz.:

$$p_a^2 - p_e^2 = \frac{\gamma \times Q^2 \times L}{86{,}400^2 \times D^5} \times c. \quad (1)$$

in which:

$$c = 126 \times \left(0.12 + \frac{0.226}{\sqrt{D}}\right). \quad (2)$$

D = actual inside pipe diameter, in.,

Q = cubic meters per day at 760 mm and at flow temperature,

L = length of the horizontal gas pipe, meters,

p_a, p_e = initial and final pressures in kg per sq cm abs,

γ = specific gravity in kg per cubic meter at 760 mm and at flow temperature.

Note: The above formula is based on an equation given by R. Biel in "Forschungsarbeiten, Heft 44 (1907)," which is applicable to rough pipes. The degree of roughness was II in Biel's classification (mild steel line pipe). Biel's equation was integrated to make it applicable to gas flow with high pressure differences and converted to the present units.

Formula (1) may be written in the form:

$$\sqrt{(p_a^2 - p_e^2)} = \sqrt{\gamma} \times Q \times \sqrt{L} \times \sqrt{f(D)} \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

in which:

$$f(D) = \frac{126 \times \left(0.12 + \frac{0.226}{\sqrt{D}}\right)}{D^5 \times 86{,}400^2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

By taking logs throughout, (3) becomes:

$$\log \sqrt{(p_a^2 - p_e^2)} = \log \sqrt{\gamma} + \log Q + 0.5 \log L + \log \sqrt{f(D)} \quad . \quad (5)$$

Such an equation can be solved by means of a nomograph composed of a number of parallel logarithmic scales. As Q and L are variable over a very wide range, Q is represented by the product $Q' \times 10^q$, Q' having a value between 1 and 10. Similarly:

$L = L' \times 10^l$.

Substituting the above values of Q and L in equation (5) we get:

$$\log \sqrt{(p_a^2 - p_e^2)} = \log \sqrt{\gamma} + \log Q' + \log 10^q + 0.5 \log L' + 0.5 \log 10^l + \log \sqrt{f(D)} =$$
$$= \log \sqrt{\gamma} + \log Q' + 0.5 \log L' + \log \sqrt{f(D)} + (q + 0.5l) \quad . \quad . \quad (6)$$

$(q + 0.5^l)$ is to the total exponent of 10.

It should be realized that if any value of Q or $L > 10$ is read off on the logarithmic cycle ranging from 1 to 10, we have actually altered its limits into 10^n and 10^{n+1}. It will be evident that then the zero point of the scale is moved downwards. Consequently, the D scale along the reference line, marked D (see Fig. 1), should be also moved in accordance with the value $(q + 0.5l)$.

A nomograph with such a movable scale, although quite feasible, is, however, difficult for reproduction.

Another possible method is to add a scale $(q + 0.5l)$ parallel to the reference line D in order to find the inside pipe diameter on a fixed D scale for a certain total exponent of 10.

In the nomograph under discussion we have preferred to add a graph to the reference line D in order to obtain the correct position of the D scale along the reference line D for every value of $(q + 0.5l)$.

This graph consists of:

1. A set of parallel vertical lines each marked by value of $(q + 0.5l)$.
2. A set of sloping lines, each marked by the value D.
3. A set of horizontal lines.

In this way, by intersection of the sloping lines with any vertical line, representing a certain value of $(q + 0.5l)$, we get on this vertical line in a D scale that, when projected horizontally to the D line, gives the correct location of this scale on the reference line D.

With this method we perceive at a glance which diameters cannot be considered at all, because they would require either an inlet pressure greater than 100 kg per sq cm abs. (vanishing diameters at the bottom) or they would give a pressure drop lower than desired for economical operation (vanishing diameters at the top).

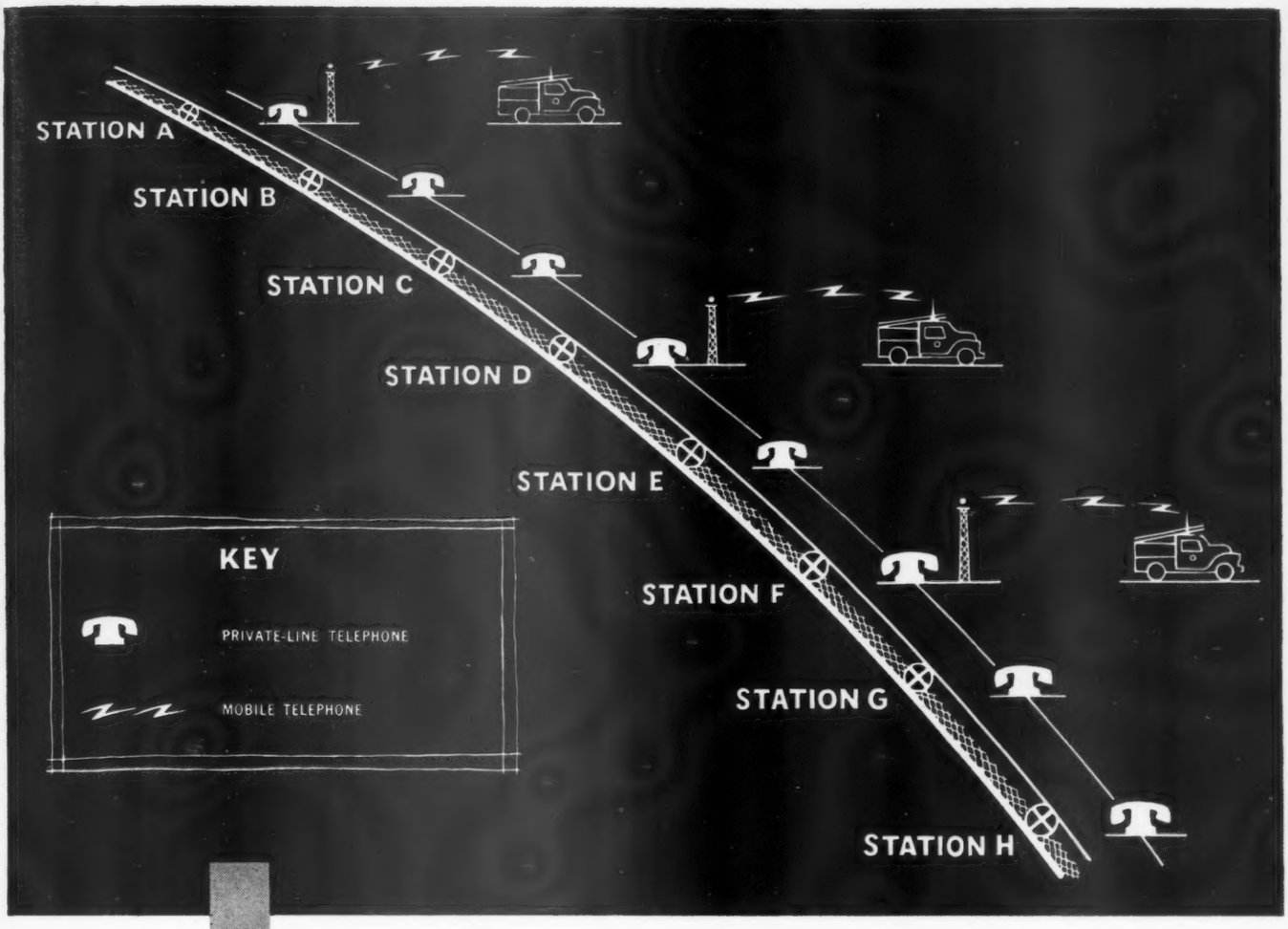
The nomograph consists of the following scales:

Main scales: A scale ranging from 1 to 10 serves for values Q' and L'. The actual inside pipe diameter scale, ranging from 1 in. to 36 in., serves to mark the sloping lines. The scale for the total exponent of 10, ranging from 1.5 to 10, serves to mark the vertical lines. Finally we have the specific

EXCLUSIVE

NOMOGRAPH FOR COMPUTING HORIZONTAL GAS PIPE LINES.
Nomenclature:
L = Length of the horizontal gasline in metres,
Q = Gas Volume in m³/D. at 760 m.m. and at Flow Temp.
D = Actual inside pipediameter in inches.
Pa = pressure at inlet kg/cm² abs.
Pe = pressure at outlet kg/cm² abs.
sp.gr. = specific gravity in kg/m³ at 760 m.m. and at Flow Temp.
D = Actual inside pipediameter in inches.
Total Exponent of 10 = (q+0,5(l).
% PRESSURE DROP
Reference Line
L' and Q'
D
B Q
L
A
sp.gr.

FIG. 1.



How much communications do you really need?

No two pipe lines are exactly alike—in their size or shape, in the terrain they cover, in the jobs they do. So no two pipe lines have exactly the same communications needs.

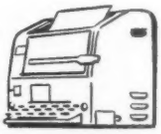
Step by step with the pipe-line industry, the Bell System has been developing communications that come as close as possible to fitting your needs.

The Bell System means service. The service we provide varies with the needs. We provide—by coaxial cable, microwave radio and wire—a wide variety of services. They include private-line telephone, mobile telephone, teletypewriter, and channels for facsimile, metering, and remote station control. In these fields our research is continuous and our experience nationwide.

In every instance, our recommendations include what we think is right—not too little, not too much. And we provide all of our pipe-line customers with the newest developments in the field of pipe-line communications.

Your Bell Telephone Company will be glad to study your communications problems and needs without charge.

PRIVATE-LINE TELEPHONE


TELETYPEWRITER

MOBILE TELEPHONE

METERING CHANNELS

BELL TELEPHONE SYSTEM

gravity scale, ranging from 0.5 to 1.5.

Auxiliary scales: p_e and p_a/p_e; p_a and p_e/p_a.

Reference lines are denoted by A, L, B, Q and D.

The value $\sqrt{(p_a^2 - p_e^2)}$ on the reference line B need not be read off, because any point on this line is directly connected with another value, viz. p_a, p_e or specific gravity.

The per cent pressure drop $= \frac{p_a - p_e}{p_a} \times 100$ is immediately read off by means of adjacent scales for any ratio of p_e/p_a or p_a/p_e.

If either p_e or p_a and the per cent pressure drop are known, we readily arrive at $\sqrt{(p_a^2 - p_e^2)}$ and, inversely, if this value has been located on the reference line B, the ratios p_a/p_e or p_e/p_a are easily found if either p_e or p_a is known.

For instance, $\sqrt{(p_a^2 - p_e^2)} = 30$ and $p_e = 40$. Align these points to locate a point on the scale $p_a/p_e = 1.25$. Therefore, $p_a = 1.25 \times 40 = 50$; pressure drop = 20 per cent (see dotted line).

$\sqrt{(p_a^2 - p_e^2)} = 30$ and $p_a = 50$. Align these points to locate a point on the scale $p_e/p_a = 0.80$. Therefore, $p_e = 0.80 \times 50 = 40$; pressure drop = 20 per cent (see dotted line).

It should be noted that we can arrive in two different ways at the same point d on the reference line D by starting from a point *a* on the reference line A (see dotted lines on the accompanying nomograph).

1. Align any point *a* on the reference line A with a point L′ to intersect at a point *b* on the reference line L; align this point b with Q′ to locate the point d on the reference line D.

2. Align the above point *a* with Q′ to intersect at a point *c* on the reference line Q; align this point *c* with L′ to locate the same point *d* on the reference line D.

This contributes to the flexibility.

Manual for Use of Nomograph

Formula (1) is a six-variable equation. We shall assume five quantities known and determine the unknown nomographically.

The following 4 cases are:

1. Known: Q, L, D, p_e, γ; unknown p_a (p_a and p_e are interchangeable).

2. Known: Q, L, p_a, p_e, γ; unknown D.

3. Known: L, D, p_a, p_e, γ; unknown Q.

4. Known: Q, D. p_a, p_e, γ; unknown L.

Problem 1

Given: Q = 120,000 cu meters per day at 760 mm and at flow temperature,
L = 50 km = 50,000 meters,
D = 10 in.,
sp gr = 0.8 kg per cu meter at 760 mm and at flow temperature,
p_e = 2 kg per sq cm abs.

To be found: p_a.

Solution: $Q = Q' \times 10^q = 1.2 \times 10^5$
$L = L' \times 10^l = 5 \times 10^4$

Thus the total exponent of $10 = q + 0.5l = 5 + 0.5 \times 4 = 7$.

The point of intersection of the vertical line marked 7 with the sloping line marked D = 10 in., viz. *e*, is projected horizontally to the point *f* on the reference line D. Align *f* and L′ = 5 to intersect at a point *g* on the reference line Q; align this point with Q′ = 1.2 to locate the point *h* on the reference line A.

We arrive at the same point *h* if we align the above point *f* with Q′ = 1.2 to intersect at a point *i* on the reference line L. Align *i* with L′ = 5 to intersect at the same point *h* on the reference line A.

Then proceeding, align *h* with the sp gr = 0.8 to intersect at a point *k* on the reference line B. Align *k* with $p_e = 2$, cutting the scale p_a/p_e at a value 2.39 (m). Hence the absolute pressure at the inlet then becomes: $p_a = 2.38 \times 2 = 4.76$ kg per sq cm abs.

If p_a instead of p_e has been given, align k with p_a to intersect the scale p_e/p_a. This ratio determines the outlet pressure.

Problem 2

Given: p_a = 4.76 kg per sq cm abs,
p_e = 2 kg per sq cm abs,
sp gr = 0.8 kg per cu m at 760 mm and at flow temperature,
Q = 120,000 cu m per day $= 1.2 \times 10^5$ cu meters per day at 760 mm and at flow temperature,
L = 50 km = 50,000 meters $= 5 \times 10^4$ meters.

To be found: The inside pipe diameter in inches.

Now we shall begin from the p_a/p_e scale. Connect $p_a/p_e = 2.38$, point *m*, with $p_e = 2$ to locate a point *k* on the reference line B. Connect this point *k* with the sp gr = 0.8 to find a point *h* on the reference line A. Connect this point *h* with Q′ = 1.2 to locate a point *g* on the reference line Q. Connect this point *g* with L′ = 5 to find a point *f* on the reference line D.

We arrive at the same point *f* if we connect the above point *h* with L′ = 5 to locate the point *i* on the reference line L. Connect this point *i* with Q′ = 1.2 to find the same point *f* on the reference line D.

Then proceeding, draw a horizontal line through point *f*, cutting the vertical line marked $7 = (q + 0.5l)$ at the point *e*. Read the sloping line passing through this point *e*, giving actual inside pipe diameter, D = 10 in.

Problem 3

Given: p_a = 4.76 kg per sq cm abs,
p_e = 2 kg per sq cm abs,
sp gr = 0.8 kg per cu m at 760 mm and at flow temperature,
L = 50 km = 50,000 m $= 5 \times 10^4$ m,
D = 10 in.

To be found: Q.

Following the same dotted lines as in the foregoing examples, viz. *m-k-h-i*, we arrive at *i* on the reference line L.

As the quantity of gas Q is unknown, we cannot determine the total exponent of $10 = (q + 0.5l)$. We only know the value of $0.5l = 2$. Therefore we have to proceed by trial and error and find a point of intersection of the sloping line marked 10 in. with a vertical line marked $(q + 2)$ (q being an integer), which, when projected horizontally on the reference line D, gives a point *f*, located in such a way that, when connected with *i*, this line cuts the scale Q′ between the limits 1 and 10. It is readily apparent that there is only one solution, and this determines the value of $(q + 0.5l = 7$ and Q′ = 1.2.

Hence $q = 7 - 2 = 5$ and $Q = 1.2 \times 10^5 = 120{,}000$ cu m per day at 760 mm and at flow temperature.

Problem 4

Given: p_a = 4.76 kg per sq cm abs,
p_e = 2 kg per sq cm abs,
sp gr = 0.8 kg per cu m at 760 mm and at flow temperature,
Q = 120,000 cu meters per day $= 1.2 \times 10^5$ cu meters per day at 760 mm and at flow temperature,
D = 10 in.

To be found: The length of the pipe line.

Following the same dotted lines as in the foregoing examples, viz. *m-k-h-g*, we arrive at *g* on the reference line Q.

Again the value $(q + 0.5l)$ is unknown, as we do not know the length of the line. In this case, however, q = 5.

So we have to find a point of intersection of the sloping line marked 10 in. with a vertical line marked $(5 + 0.5l)$ (l being an integer). This point, when projected horizontally to the reference line D, should give a point *f*, which, when connected with *g*, cuts the scale L′ between 1 and 10.

Again there is only one possible solution and we find $(q + 0.5l = 7$ and L′ = 5. So that $0.5l = 7 - 5 = 2$. Therefore, l = 4 and $L = 5 \times 10^4 = 50{,}000$ meters = 50 km. * * *

Developments in Products Pipe Line Technology*

Advancements have been rapid since World War II, a major trend being toward completely automatic and unattended pumping stations

J. R. SHIPLEY†

THE products pipe line systems of this country have been progressing rapidly since the war. Many of the problems that have been met and solved have been reported in various papers and articles. It is the purpose of this paper to report on various methods and studies that have been made or reported recently concerning these problems for the purpose of developing new and better solutions.

Fire-Fighting Systems

There have been advances in the technique of systems for extinguishing fires that might occur at products pipe line installations.

The majority of stations are equipped with fire extinguishers. Almost all are of the type that discharges carbon dioxide or a powder that chemically releases carbon dioxide by action of heat.

One operator[1] recently reported his experience with the installation of various types of fixed systems for the protection of products pipe line stations and terminals. This company has installed systems including the single-powder chemical system; dual-powder chemical system; 6-per cent high- and low-expansion mechanical systems, and 3-per cent mechanical systems. It was reported that all the types of systems that this operator has installed have operated satisfactorily but that, from his experience, he believes the 6-per cent low-expansion mechanical system is the best for most products pipe line systems. Most of these systems consist of a water pump driven by a gasoline engine, or an electric motor, and an around-the-pump proportioner that draws in the air-foam liquid from a storage tank and introduces it into a fixed pipe system. This piping system includes the installation of distributor nozzles in the pump room and manifold area, and several hydrants situated in strategic areas. The foam is generated by the introduction of air by an aspirator to the solution of water and air-foam liquid close to the distributor nozzles. Foam for a hose stream is made by using an aspirator that is a part of the hose nozzle.

Another company[2] reported that most of its stations are protected by fog-foam systems. This system is essentially a foam system, with the foam discharged from the distributor nozzles at fairly high pressure so as to create a fog, which this company believes is advantageous in securing the immediate cooling effect obtained with water fog, in addition to the advantages of using foam.

The usual installation requires the manual starting of a system after the occurrence of an emergency, but these systems have one additional feature. There are heat-actuated devices installed in the manifold area and pump room. When a temperature rise exceeding a rate of 15 F per minute occurs, these devices trip a release in a deluge valve that turns on the ignition circuit of an engine, which drives the water pump and actuates a starting device that automatically starts the engine. The system is flooded at all times to the deluge valve, and the opening of the valve allows water to enter the pump; therefore, the system automatically applies foam to the danger areas upon information from the heat-actuated devices.

There are other automatic systems for applying carbon dioxide to pump rooms. One recent development is a system of blowing dry powder into a pump room by the use of an inert gas pressure. This system is controlled by heat-actuated devices, and includes devices that automatically close the doors and windows.

Pipe Line Filters

A continuing study is being made by a large number of companies to improve the method of filtering the pipe line stream for the purpose of removing water and rouge so as adequately to protect the meters and pumps against wear and to deliver bright, clean products.

One company[3] has done extensive experimenting during the last few years on several different types and makes of filters. These types include the direct type of filtration, which consists of various types of hay tanks and felt-type strainers, filters that use the edge-type filtration principle, and a self-cleaning filter that uses a Dutch-weave strainer basket. The conclusions reached by this company on the problems of filtering are that it is very difficult to obtain adequate filtration with high throughputs when particle sizes are extremely fine; that the problem is complicated further by the formation of emulsion containing rouge, water, and product, and that it appears that the problem would be simplified considerably if a two-step operation could be developed whereby the emulsion could be broken and the solids separated in the first step and the water removed in the second step.

As an attempt at this solution, this company is now installing a magnetic separator to remove the rouge— following which a filter would be used to remove any water. The magnetic separator attacks the problem from the magnetic quality of the iron oxide. A flat-face permanent magnet pulley, 18 in. in diam and 36 in. in length, is mounted eccentrically in a 24-in. pipe barrel. The product is directed by barriers, so that it flows in a thin sheet over the face of the pulley. The pulley is revolved by a drive at 17 rpm. Over a sump in the barrel is mounted an induction wheel, which consists of 4 vanes on a shaft extending the length of the pulley. This wheel is to remove the particles collected by the pulley by attracting the particles onto vanes on the induction wheel by induced magnetism—following which they are dropped as the wheel revolves for the reason that it rapidly loses the magnetism induced by the pulley.

Another company also has installed a magnetic separator. This separator uses an electromagnet for attracting the particles from the stream. The magnet is cleaned by bypassing it and then by taking the current off the magnet. Any rouge collected drops to the bottom, and is drained from a connection at the bottom. This company advises that it has obtained excellent results in the removal of magnetic oxide, and that it only requires a minute to clean the separator.

Meter Installations

One of the problems in metering is the printing of tickets for the purpose of covering each product as these products follow one another through the line, as well as for the purpose of obviating the necessity of making several tickets when more than one meter is used at a time.

One company uses dual counter-printer drives on meters where "flying switches" are made. This device enables the mounting of two counter-printer heads on a single meter to facilitate the handling of meter tickets and to eliminate the necessity of shutting down the stream through the meters when product deliveries are to be switched from the receiving tanks of one shipper to the receiving tanks of another shipper at the same terminal. With two counter-printer

*This paper was prepared by the Subcommittee on Products Pipe Line Technology as a report to the Central Committee on Pipe Line Technology of the API Division of Transportation, and was presented before the American Petroleum Institute at Chicago, Illinois, November 6, 1951.

†The Standard Oil Company (Ohio), St. Louis, Missouri.

heads on one meter, a lever-operated swing-drive gear allows switching from one printing head to the other so that a delivery of this type can be made quickly and efficiently. The prior placing of tickets in the second set of heads enables the speed of a delivery change to be limited only by the time required for the closing of the valve on the first delivery and the opening of the valve for the next delivery.

Another company has printers that integrate information from four meters. These printers are equipped so that the information can be switched from one printer to another without loss of time.

Another company is installing a system with a consolidated ticket printer that handles throughput from any three meters in a bank of nine meters. The selection of meters is made at the printer, which electrically interlocks the meters selected so that no other meter can be used. The printer marks throughput for those meters separately. After a ticket has been printed, the meter register automatically returns to zero. In addition to the tickets printed, the meter printer retains a roll record of operation through it. It is stated that this installation will reduce loading time approximately 40 per cent, and that it will place a check on products being delivered so as to prevent errors.

Cutting of Batches of Products

One of the problems that faces most products pipe line operators is the cutting of batches at terminals for the purpose of preventing contamination beyond that allowed by a shipper's specifications. There are many different methods in use today, but one of the most recent developments is the use of radioactive tracers. This development also reflects the foresight of most of the industry in adapting new products to the operations of oil companies.

For more than a year the use of radioactive tracers to mark the junctions between products in its Salt Lake-Northwest products pipe line has been a normal operating procedure of Salt Lake Pipe Line Company, a Standard Oil Company of California subsidiary. This system of marking interfaces was developed by the California Research Corporation, and patents have been applied therefor. A very small amount—a few cubic centimeters—of an oil solution of an organic compound of radioactive antimony 124 is injected into each interface between prduct batches as the interface leaves the initial pump station of the line. This is done whether the interface be between similar products of different shippers or dissimilar products such as gasoline and diesel fuel.

Injected at the time when the interface is essentially a sharp cleavage between the adjoining products, the radioactive tracer spreads with the commingling products as the interface develops in volume in its passage through the pipe line. The concentration of the tracer and, therefore, the radioactivity of the product stream, at any point in a developed interface is thus a function of the amount of product intermixture at that point.

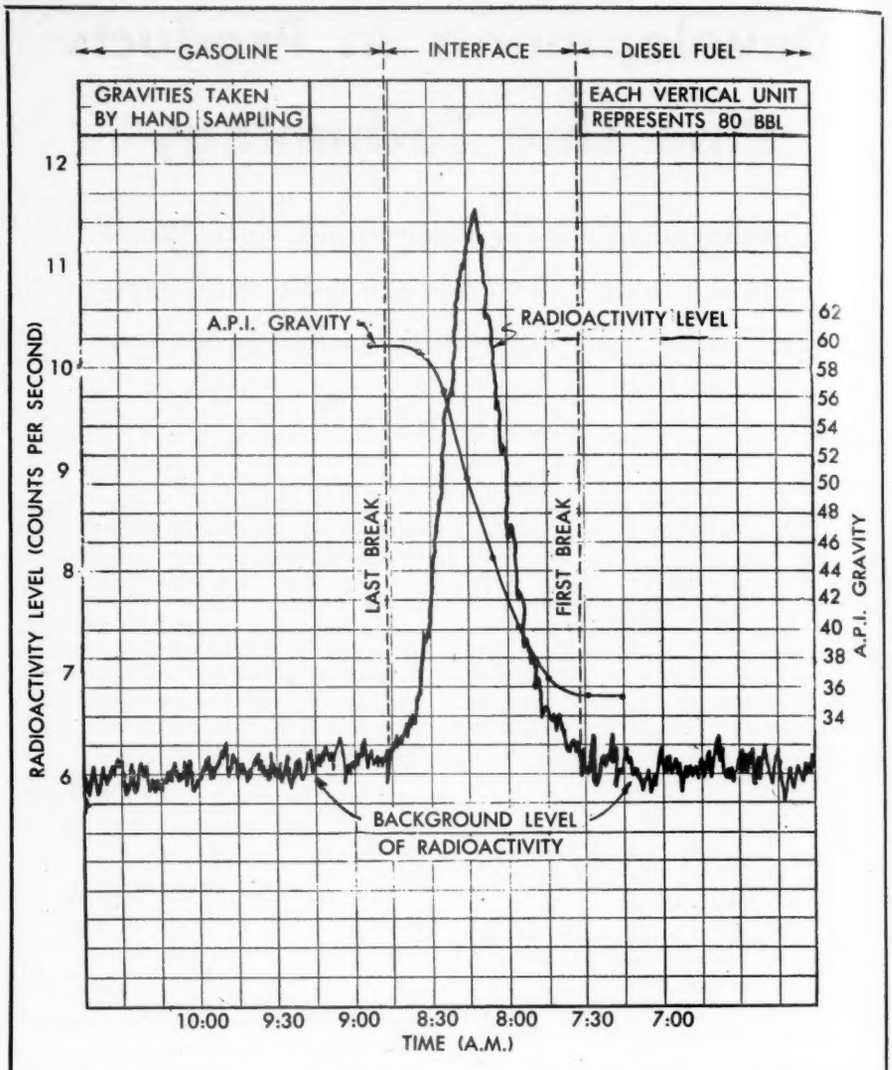


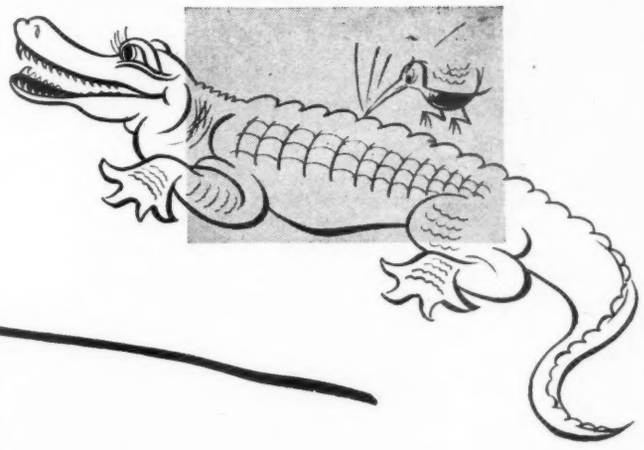
FIG. 1. Salt Lake Pipe Line Company: Comparison of radio-activity level and API gravity—Interface No. 5 to 18. Pasco terminal, June 13, 1951.

In operation, each distribution or delivery station along the pipe line is equipped with an installation of Geiger-Mueller counters connected to indicating and recording meters. The rate of radiation from the pipe line stream is thus read directly by the operator.

As the head end of an interface arrives at a station, the radiation level begins to rise; this level reaches a peak when the center of the interface—the point of greatest commingling between products—is passing; then subsides as the following half of the interface goes by. It is thus very simple for an operator to determine: 1, the "first break," or point where product commingling begins; 2, the "peak," or point of equal product mixture; and, 3, the "last break," where the interface ends and the pure product that follows is flowing in the line.

To permit refinement of the method just described—whereby an operator at a delivery station can immediately identify and act upon the initial, middle, and final points of an interface during its arrival — an additional Geiger-Mueller counter installation has been made a few miles upstream of certain key stations, where interfaces are normally removed from the line with product deliveries. The impulses from each of these upstream counters are amplified and telemetered to the adjacent delivery station, where they show on a second recording meter. In this way the operator has a complete chart of the approaching interface, well in advance of its arrival at his station. He can thus determine its total volume and the regularity or irregularity with which mixing of the adjoining products has taken place in transit—all before the interface has reached his delivery station. By observing the peak value of radioactivity at the upstream station, he can—with a simple procedure—determine the activity level at which he should switch the stream to deliver any required portion of the interface into tankage. It is thus possible to deliver from the line with a consignment of

Like the 'Gator's tough skin that shields what's within . . .



Johns-Manville Asbestos Felts shield oil and gas pipelines

Johns-Manville Asbestos Pipeline Felt—*the only type of wrapper that has survived more than 50 years of service in all types of soil*—now protects more than 100,000 miles of oil and gas pipelines!

A sturdy, inorganic product, Johns-Manville Asbestos Felt resists rot and decay, stands up in both acid and alkali soils. It has the thickness and toughness needed to shield pipeline enamels from earth load and soil stresses. And it permits the protective enamel coating to properly function against corrosion.

Johns-Manville Asbestos Felt is flexible; wraps easily without cracking. It guards enamel from impact damage both during installation of field-wrapped pipe, and during transportation and installation of mill-wrapped pipe.

There are important economic advantages, too! In addition to reducing maintenance expense, Johns-Manville Asbestos Felt adds many years of life to the pipeline. For further information and a sample of Johns-Manville Asbestos Pipeline Felt, mail the coupon below.

Johns-Manville
Asbestos
PIPELINE FELT

Johns-Manville
Box 290, New York 16, N. Y.

Please send me a copy of the sample folder on Johns-Manville Asbestos Pipeline Felt, PP-22A.

Name_____

Address_____

City_____ Zone____ State_____

product a portion of an interface containing a known amount of the adjoining product such that the delivered consignment will remain within its specifications.

Fig. 1 compares the gravities and radioactivity levels through a gasoline-diesel-oil interface. The activity level has been traced directly from the recorder chart. Carefully-timed hand samples were taken during the passage of the interface for determination of API gravities.

It will be noted in Fig. 1 that a radioactivity background, which averages 6 counts per second, is shown before and after passage of the interface. This background "hash" is the result of natural radioactivity in the area and of random cosmic rays from space. The first break in radioactivity and the corresponding first gravity break occur where the radioactivity level rises above this background. The peak radioactivity level—in this case approximately 11½ counts per second—occurs at the point of the interface where the original injection was made at the initial pump station of the line 569 miles upstream and 18 days earlier. This peak, as can be seen from the gravity curve, represents the center (or point of equal commingling) of the interface. The last break, or the end of the interface, is shown by the point where the radiation level returns to that of the background.

The peak radiation level shown in Fig. 1, approximately 11½ counts per second, illustrates the extreme sensitivity of the instrumentation as well as the absence of any radiological hazard. A radium-dial wrist watch, held beside the Geiger-Mueller tubes at the delivery station, gives a level of from 8 to 12 counts per second. In addition, the radio-isotope used in the preparation of the tracer solution has a half-life of only 60 days, so that, even in its most concentrated form in the pipe line, its radioactivity will disappear in a short time.

Two new automatic pumping stations on the Salt Lake-Northwest products pipe line were recently completed. These stations are normally started and stopped by line flow. So as always to have the same product in the pumps and manifolding as in the line when the stations are shut down, arrangements are made for automatic starting and operating of the pumps while each interface is passing the station. This is done through the use of the tracer material in each interface. A nest of Geiger-Mueller tubes is installed on the pipe line a little more than a mile upstream of each of the automatic stations. As an interface passes this tube nest, the radioactivity of the tracer—telemetered to the station—automatically starts the pump. The pump operates for a preset time, until the interface has passed and the manifolding is filled with the new product, and then automatically shuts down if the line flow rate is still below that required for its operation.

As a further use of radioactivity in the line, radioactive cap screws attached to pipe line scrapers have been used in the line. These cannot be used for locating lost scrapers, inasmuch as for reasons of safety the level of radioactivity must be kept too low to penetrate the earth cover of the buried line; but they have been very useful at those stations equipped with upstream detection apparatus for warning station operators of the impending arrival of a scraper. Used during the period when large quantities of rust and scale from the new line were being carried in by the scrapers, they made it possible for the operators to bypass meters and to divert the stream to a slop tank before the arrival of the heavy sludge—thus avoiding plugging and collapse of strainer baskets, as well as excessive wear and damage to meters and pumps.

The use of a radioactive tracer for marking interfaces and for starting automatic pump stations is particularly applicable to the operating conditions of Salt Lake Pipe Line Company's line, for the reason that this line handles entirely segregated products in relatively small batches. The minimum tender is 15,000 bbl, and batch sizes average around 22,000 bbl. This makes the handling and disposition of interfaces extremely important, for the reason that there is often not enough product in adjacent batches to provide for the absorbing of the commingled products of an intermediate interface without their being thrown off specification. The sensitivity of control provided by the tracer has made it possible to minimize the amount of gasoline-gas-oil transmix that must be returned to a refinery for rerunning.

The system is applicable, however, to any pipe line operation. It provides the operators with a control that is independent of properties such as gravity and color, and which requires no particularly skillful manipulation; it also makes possible a simple but exact distribution of interfacial mixtures at delivery stations.

An oil company is using a system that operates a 450-mile pipe line from Illinois to Ohio from a master control point 850 miles away in New York City. Progress of products through the line is followed by dispatchers on a 17-ft long control board.

Electrical Controls

One trend in products pipe line operation is toward remote operation of facilities and more electrical controls. A large number of the valves now installed at stations and terminals are equipped with electric operators.

One example of remote control is represented by the installation at a terminal of one pipe line company. All valves at the tanks and tank booster pumps are equipped with electric operators. These valves and pumps are remotely controlled from a central control board. Because of the number of valves and pumps involved, which would require a large number of individual wires if separate control were used, a method that combines various frequencies from 10,000 to 22,000 cycles transmitted through a coaxial cable is used to actuate relays at the valves. There is a further interlock that, when the suction valves at a booster pump are actuated, energizes the pump; thereupon a signal is transmitted to the central control when the pump comes up to speed. This signal is actuated by a pressure oculator.

Plantation Pipe Line Company has installed electric pressure gages in one terminal, and these have proved so satisfactory that they are being installed at all stations now under construction in an expansion program. The original system, with 5 sight indicating pressure gages, uses SR-4 strain-gage pressure cells as pressure pickups, as well as indicating meters to provide pressure indications on the gage board in the control room. A voltage-regulated electronic-rectifier power supply provides low direct-current voltage to the Wheatstone bridge in each pressure cell. An indicating meter is connected across the output legs of each bridge, and is calibrated in pounds per square inch. The output of the pressure cell is perfectly linear with respect to pressure. Push-button calibration is provided for accurate calibration of the gage system.

Pressure cells are also used as pressure pickups for automatic pressure control of the station. Two pneumatic pressure transmitters—one for suction and one for discharge—convert the electrical quantities from the pressure cells so as to control air pressure for actuating the pen arms in the controllers. Control of the air-operated control valve is conventional.

This installation has been in operation for 1½ years, and has proved quite satisfactory. Total maintenance for this period has consisted of one replacement of vacuum tubes in the power supply. On a recent deadweight test, the accuracy of this system was better than 1 per cent of full scale.

Electrical pressure gages and controls will be used in all the stations involved in the present expansion program. However, certain modifications have been made in the sight-indicating gage system. In order to use a more rugged type of indicating meter, which can be horizontally mounted in the control desk top, more driving voltage is necessary than can be supplied by the strain-gage bridge. Alternating-current voltage will be used to energize the bridge, and a single-tube amplifier will be used between the strain-gage bridge and the meter. This change will simplify the main power supply, and thus will eliminate vacuum tubes in the power supply.

Conservation

Conservation of products is an important factor in products pipe line

Pipeline on the March

. . . And a fast-stepping "march" it is with "Caterpillar" equipment in command. Just the kind of equipment that's needed to speed projects directly or indirectly associated with the national defense! To supply both rearmament and civilian activities with natural gas, the final section of the big "Super Inch" is here seen approaching its terminus near Llanada, California. With military unison, three "Cat" D8 Tractors put long stretches of welded pipe to bed — fast but gently. Of course they're outfitted with the right gear for such work. Offset track, plus added counterweighting, puts mighty lifting-and-lowering capacity into their Trackson Pipe Layers.

Because the work is tough, varied — and ceaseless around the clock — "Caterpillar" equipment has figured in the construction of most of the estimated 17,000 miles of pipeline laid in '51. It is widely preferred because (1) "Cat" machines can handle so many pipeline jobs — in clearing right of way, ditching, stabbing, welding, wrapping, doping, lowering, backfilling, cleaning up; (2) because they STAND UP under all kinds of punishment; and (3) because there is always within reach a "Caterpillar" dealer rich in experience and facilities for keeping them on the job. So, while governmental emergency demands come first —

Take your maintenance problems to your "Caterpillar" dealer* BEFORE *parts are worn beyond repair

He can build up track grousers, rerim sprockets, turn track pins and rollers for new wearing surfaces, refinish cylinder liners and crankshafts, recondition pistons, cylinder heads, radiators — salvage many other parts that will keep your machines operating dependably and lengthen their life.

CATERPILLAR, PEORIA, ILLINOIS

You're the Doctor

Good care is good medicine—for man or machine

CAREFUL LUBRICATION practices, for instance, will add much to your satisfaction through equipment performance, economy and long life. Use only recommended lubricants, changing the lubricant at proper intervals . . . and use *only* "Caterpillar"-proved filter elements. Remove dirt from fittings and clean around crankcase filler cap before adding oil. A little care saves many hours of engine life. *Consult the Lubrication Chart in your Operator's Instruction Book.* AND REREAD THE BOOK OFTEN.

CATERPILLAR

REG. U. S. PAT. OFF.

DIESEL ENGINES • TRACTORS • MOTOR GRADERS • EARTHMOVING EQUIPMENT

operations. One important phase in this problem is reduction in losses of tankage associated with the pipe line. In a recent paper Shell[4] reported on tests that this company has been conducting at its East Chicago plant. It constructed model tanks of 1000-gal capacity. Three of these tanks were of cone-roof design; one of expansion-roof design, and one of floating-roof design. From the results of the various experiments conducted at this pilot plant, the following conclusions were reached:

1. Tanks with vapor space:

a. Losses can be reduced by decreasing the volume of breathing.

b. Breathing can be decreased by providing variable vapor volume, such as by a lift roof or an external holder.

c. Breathing can be decreased by decreasing temperature change, which is affected materially by choice of paint.

d. It appears that choice of paint color is perhaps the most important in product conservation.

2. Floating-roof tanks:

a. Filling losses are very negligible.

b. Standing storage losses for tanks in satisfactory operating condition are about the same as for good conservation roofs.

c. Improvements would seem to come by reducing the exposed liquid surface area; by improving the smoothness of the inner surface of the tank shell and, consequently, improving seal tightness; and by eliminating openings through the roof.

Trends

The trend in station design is toward more automatic operation, with completely unattended automatic stations as the ultimate goal. Stations of this type have been constructed, but they are of small size. One of the pieces of equipment required to make this type of station more generally used is an entirely safe medium-capacity high-head centrifugal pump of fairly high efficiency. There are pumps available of the stuffing-boxless type, but they are limited in horsepower and efficiency. Currently a number of companies are doing research work on mechanical seals for the purpose of improving their design and making them more dependable for unattended operation. Possibly an improvement in mechanical seals will be developed that will permit the stations to run unattended safely.

One of the products that has recently come to the forefront for handling by the products pipe line systems is liquefied petroleum gas. So far the troubles inherent in the handling of this material in ordinary pipe line systems have been such that only a few companies attempt to handle this product on a routine basis. A large supply of this product is available in certain areas of the country, and the market for it is increasing substantially and rapidly. More than likely, there will be a trend toward the handling of this product on a routine basis in an increasing number of lines in the near future; i.e., as soon as the problems inherent in the handling of the material can be solved—including the problems of handling and storage at delivery terminals. It is apparent that the products pipe line companies in this country are progressing rapidly; that they are taking advantage of all available means to improve the technique of handling products through pipe lines, and that these advances will continue in the future.

Addendum

The data presented in this paper do not necessarily represent the views of this author, but summarize some of the technical papers presented to the API Subcommittee on Products Pipe-Line Technology in the past year, as well as data given to this author by various members of the subcommittee.

References

Note: All the following papers were presented at the conference of the API Subcommittee on Products Pipe-Line Technology, in Atlanta, Georgia., May 21-23, 1951.

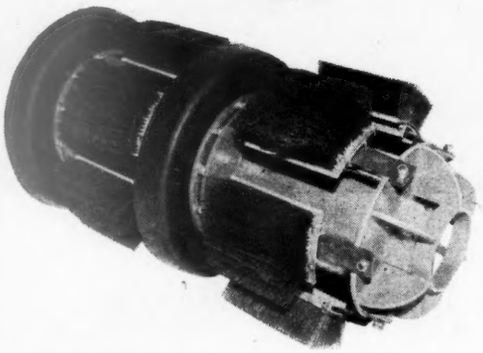
1. J. P. West [The Standard Oil Company (Ohio)], "Experience with Fire Protection for Products Pipe-Line Facilities."
2. H. C. Van Nouhuys and R. L. Smith (Southeastern Pipe Line Company), "Description of Fog-Foam Fire-Protection Facilities."
3. Ivy M. Parker and M. J. Dabney (Plantation Pipe Line Company), "Problems in Products Pipe-Line Filtration."
4. S. S. Smith and G. D. Harden (Products Pipe Line Department, Shell Oil Company), "Factors Affecting Conservation Roof Tankage in Products Pipe-Line Operations."

* * *

THE PIG WITH THE POKE CLEANS PIPE LINES

MORE BARRELS PER DOLLAR . . .
THROUGH OIL PIPE LINES
CLEANED BY WILLIAMSON PIGS

Type JR Pig 2" to 5" sizes. Economical and Rugged.

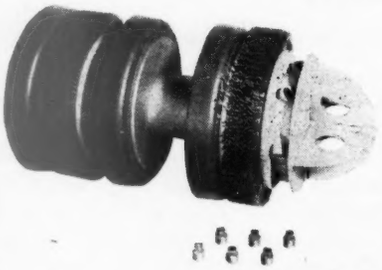


Type GP-4 Pig 16" to 30" sizes.

Similar design for 10" to 14" sizes.

Brushes expanded by arched springs.

Brush and cup service life up to 1,000 miles.



Type RC-50 Pig 8" to 14" sizes.

6" size, similar, type SC-50.

Jet-rotation feature distributes wear of brushes and cups.

REPRESENTATIVES

H. E. Davis, Los Angeles 15, Calif. James S. Kone Co., Amarillo, Texas. Keyes Tank Co., Provo, Utah. Keyes Tank & Supply Co., Casper, Wyoming.
Canadian Equipment Sales & Service Co., Ltd., Edmonton, Calgary, Toronto, Canada

T. D. Williamson, Inc.
TULSA 9, OKLAHOMA

LINK-BELT SPEEDER with clamshell, cleaning out a trench for a new pipeline. Remarkably fast and easy operation, unusual stability and strength, and quick convertibility, are Link-Belt Speeder advantages that bring substantial time and money savings in pipeline work.

TOUGH AS A TANK!

All-welded steel construction means extra strength without extra weight

LINK-BELT SPEEDER

Pound for pound, the Link-Belt Speeder all-welded frame is stronger than other types of structures. Box section construction adds still more strength, uniting the entire base in one rugged, yet flexible structure by means of unrestricted design. Resistance to impact and twist is greater. Deep recessing and full enclosure of mechanism (especially desirable for river crossings), and high ground clearance provide maximum protection and maneuverability. Field maintenance is simple and quick. In fact, in every way, Link-Belt Speeder all-welded construction is truly "tough as a tank."

All-welded steel construction is but one of the many engineered advancements . . . work-tested and time-tested . . . that make Link-Belt Speeder the choice of alert owners and operators everywhere. If you are looking for a Shovel-Crane that does more work, more kinds of work, more of the time . . . look up Link-Belt Speeder. See your distributor, or write

LINK-BELT SPEEDER CORPORATION

12,594

Builders of the most complete line of shovels, cranes and draglines
CEDAR RAPIDS, IOWA

Application of Pipe Line Control Equipment to Field Operations*

Improved operating techniques and reduced costs are the primary advantages gained

H. T. CHILTON, JR.†

OUTSTANDING contributions to improved pipe line operating techniques have been made in recent years through the development and use of pipe line control equipment. Larger and more modern relay or main line systems have been the principal recipients to this trend, however, the application of control equipment to smaller stations and field installations offers expanding potentialities toward effecting operating economies, efficiently meeting the increasing complexities in operating procedure, and gaining valuable experience that may later be applicable on a broader scope.

With the rapid development of many types of control equipment applicable to pipe line operations, the use of automatic controls to supplement, reduce, or eliminate attendant manpower is justly gaining in popularity. Many useful applications of control equipment at medium-sized pumping stations and small field installations is resulting from a closer contact between the technical personnel and field operations since control engineering must of necessity include a basic knowledge of the actual operating procedures and requirements.

Automatic start and stop devices on pumping units are the most widely used controls on field installations. Where on-off type controls are used for scheduled primary control at normally unattended field pumping stations, either time, pressure, flow, or liquid level controls are most common. Their individual application is governed by local conditions, which form the basis of selection to provide the desired results. In general, these controls may be used to make or interrupt the starting circuit for automatic start or stop of electric motors, ground the magneto for shutdown of ignition engines, or cut off the fuel supply for shutdown of either ignition or diesel units.

Secondary protective shutdown controls of many types are available, which are designed to protect pumping equipment and lines against abnormal or emergency conditions. In oil field electric equipment, overload, undervoltage, surge protection, reverse phase, short circuit, and motor thermal protection may be incorporated as an integral part of the starters as conditions demand. Internal-combustion engines may be equipped with various standard temperature or pressure shutdown controls. Additional protection may be provided by equipping prime movers or pumps with shutdown controls to protect against excessive bearing or case temperatures, loss of suction, restricted discharge, packing or seal failure, vapor locking, forced feed system failures, etc. Each installation presents its own peculiar problems, which must be evaluated to establish the economic or operating limitations that govern the intelligent selection and proper application of control equipment.

Continuous control to maintain optimum pumping conditions within design limits usually dictates the use of a pilot or instrument type controller. The variable factors that comprise the bulk of field controller applications are pressure, flow, and liquid level. These variables are normally controlled on centrifugal pumps by throttling with a control valve set in the discharge line and on positive displacement pumps by regulating the bypass valve or varying the speed of the prime mover. In conjunction with these controllers, it is advisable to use secondary protective shutdown devices that will protect against controller failure or abnormal conditions that cannot be remedied by controller action.

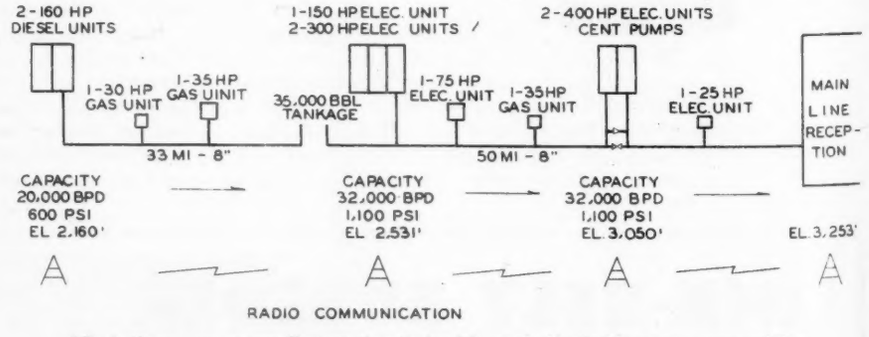
Specific Installations

Illustrations are shown of field control equipment currently installed and operating in the West Texas area. Fig. 1 shows a schematic layout of a normally unattended system, which includes two main gathering stations and one relay station (totaling 1870 hp) pumping through a total of 83 miles of 8-in. discharge line.

Of the three stations in this system, the only outstanding normally unattended station operating problems involved were at the two stations downstream from the 320-hp diesel station. The problems encountered at these two stations were as follows:

1. As the 750-hp station (hereafter referred to as the originating station) and the 800-hp relay station are dependent one on the other in order to operate within design limits, controls had to be provided to balance out the units on line at both stations. That is, the relay station units must start or shut down automatically as dictated by the pumping condition at the relay station, and the relay station operating units in turn must control the pumping unit combination at the originating station.

2. The most common electric station failure is normally a result of a temporary power failure. Controls had to be provided, which in the event of a power failure would let either one or both sta-


2-160 HP DIESEL UNITS
1-150 HP ELEC. UNIT
2-300 HP ELEC. UNITS
2-400 HP ELEC. UNITS CENT PUMPS
1-30 HP GAS UNIT
1-35 HP GAS UNIT
35,000 BBL TANKAGE
1-75 HP ELEC. UNIT
1-35 HP GAS UNIT
1-25 HP ELEC. UNIT
MAIN LINE RECEPTION
33 MI - 8"
50 MI - 8"
CAPACITY 20,000 BPD 600 PSI EL 2,160'
CAPACITY 32,000 BPD 1,100 PSI EL 2,531'
CAPACITY 32,000 BPD 1,100 PSI EL 3,050'
EL 3,253'
RADIO COMMUNICATION

All stations run normally unattended with periodic field gager supervision.

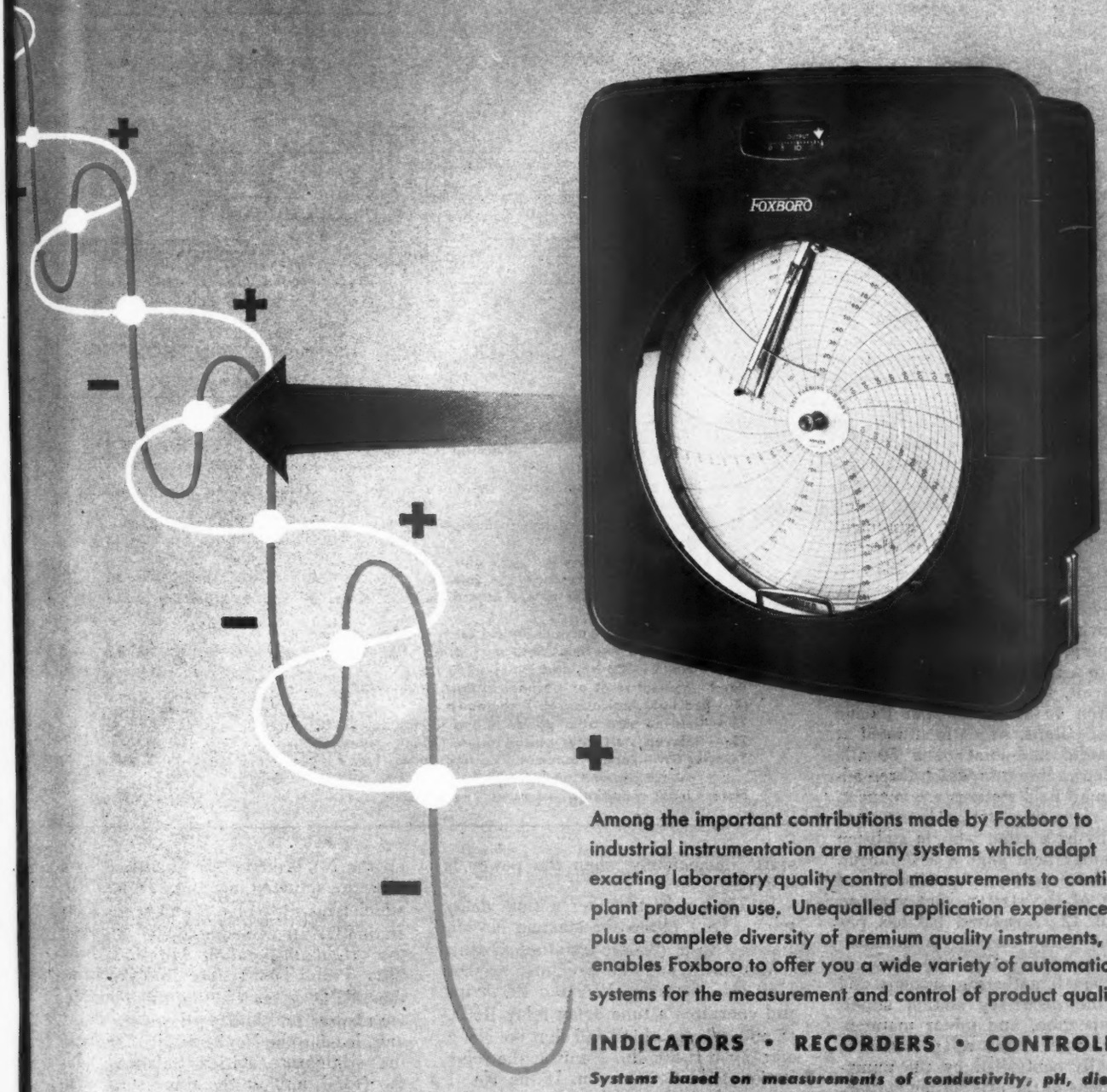
FIG. 1. Flow diagram of semi-automatic gathering station and relay system.

*Presented before Petroleum Division of American Society Mechanical Engineers, September 26, 1951, Tulsa, Oklahoma.

†Service Pipe Line Company.

better instrumentation for

QUALITY CONTROL



Among the important contributions made by Foxboro to industrial instrumentation are many systems which adapt exacting laboratory quality control measurements to continuous plant production use. Unequalled application experience, plus a complete diversity of premium quality instruments, enables Foxboro to offer you a wide variety of automatic systems for the measurement and control of product quality.

INDICATORS • RECORDERS • CONTROLLERS

Systems based on measurements of conductivity, pH, dielectric constant, oxidation-reduction potential, boiling point rise, differential vapor pressure, specific gravity . .

TRANSMISSION SYSTEMS • CONTROLLED VALVES

FOXBORO

Reg. U. S. Pat. Off.

For over 40 years, specialists in the measurement and control of temperature, pressure, flow, liquid level, humidity . . .

THE FOXBORO COMPANY, FOXBORO, MASSACHUSETTS, U.S.A.

tions go down for a short period (less than 6 min) and then come back on line in sequence until the same pumping condition existed at each station as existed before the power failure.

3. In order to simplify the operating procedures and controls required, the originating station, having reciprocating pumps, was designed to start each pump individually against a completely closed bypass valve, and the relay station, having centrifugal pumps, was designed to start each pump against an open discharge gate valve. This necessitated design of controls to prevent excessive line or load surges.

4. Secondary protective shutdown controls had to be provided at both stations to guard against limiting pressure conditions and mechanical malfunctions of the pumping equipment.

A brief explanation of the integrated controlled operation of the originating and relay station installations follows:

Normally unattended automatically controlled stations. The originating station represented by the electrical schematic shown in Fig. 1 receives oil from a normally unattended 320-hp diesel station 33 miles upstream, from a small intermediate gathering station, and from a 13,000-bbl-per-day gathering system surrounding the station. This station takes suction on tankage "floating on line" (1-20,000- and 1-15,000-bbl tank), batches two types of crude, has a capacity of 32,000 bbl per day at 1100 psi, with three electric motor-driven piston type pumps. The pumping equipment consists of two 2300-volt, 300-hp electric induction motors driving two 125-rpm Wheatley quintrulex piston pumps and one 2300-volt, 150-hp electric induction motor driving a 60-rpm Gaso duplex piston pump. The originating station pumps into a relay station consisting of two 2300-volt, 400-hp electric induction motor-driven 4-stage, 3600-rpm Pacific centrifugal pumps, which is situated at the hydraulic mid-point of a 50-mile 8-in. discharge line into which three additional small field stations are connected. The originating station is attended periodically by a gager who, in addition to his regular field gaging assignment, provides the necessary supervision and inspection of the station, and runs an average of 12 segregated batches per week. The relay station is attended periodically by a gager who runs oil from two small gathering systems and provides the necessary station supervision, inspection, and minor maintenance. Operation of the relay station is automatically controlled by the pumping conditions at the originating station.

A. Originating station operation (See Fig. 2). The originating station's operation is set up as follows:

1. *Starting sequence:* The units coming on line after a normal or power failure shutdown (when this station goes down, the relay station will, of course, go down) come on in sequence depending upon the number of units set for automatic operation in the following manner:

a. No. 3 (300-hp quintuplex unit) starts immediately when the power is restored.

b. Three minutes later a time delay relay (TS_2) closes the starting circuit, and the No. 2 (300-hp quintuplex) unit comes on. When the pressure reaches 1150 psi, a mercoid PD_1 and PD_2 trips and energizes a time delay relay RPD_2 (8-min delay), which will shut the No. 2 unit down if the No. 1 unit at the relay station fails to come on. If the No. 1 unit at the relay station comes on, the originating station's pressure is lowered to 900 psi and the mercoid PD_1 and PD_2 and time delay RPD_2 automatically reset to the normal running position.

c. Fifteen minutes after power is restored, a time delay relay TS_1 completes the starting circuit and the No. 1 (150-hp duplex) unit comes on. When the pressure reaches 1150 psi, both time delay shutdowns (RPD_2-8-min. delay on the No. 2 unit, the RPD_1 - 6-min delay on the No. 1 unit) are energized by a pressure actuated mercoid PD_1 and PD_2 which trips, If the No. 2 unit at the relay station fails to come on, the No. 1 unit at the originating station will shut down after 6 min. This reduces the pressure; thus, RPD_2 is reset before the 8-min delay elapses for shutting down the No. 2 unit, leaving the No. 3 and No. 2 units at the originating station balanced with the No. 1 unit at the relay station. If the No. 2 unit at the relay station comes on, the pressure at the originating station is lowered—PD_1 and PD_2, RPD_2 and RPD_1, are reset, and both stations are operating at capacity.

It should be noted that all three units at the originating station start against a closed bypass. Nearly all pipe lines have enough volume downstream from the station to absorb considerable "pack" and, therefore, the pressure-surges when starting up with the bypass valve closed

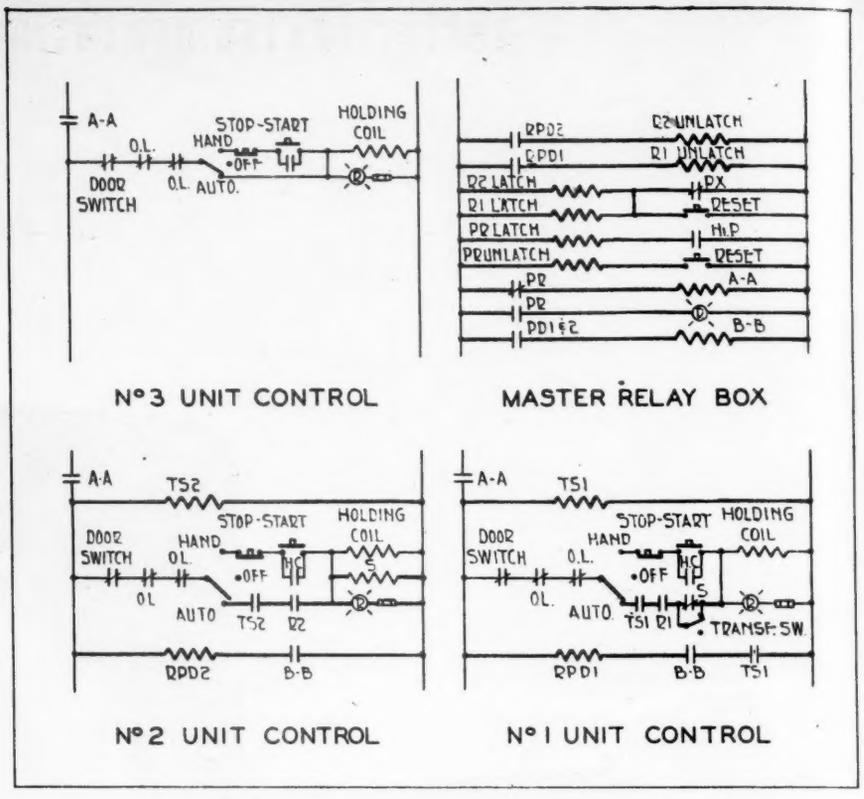
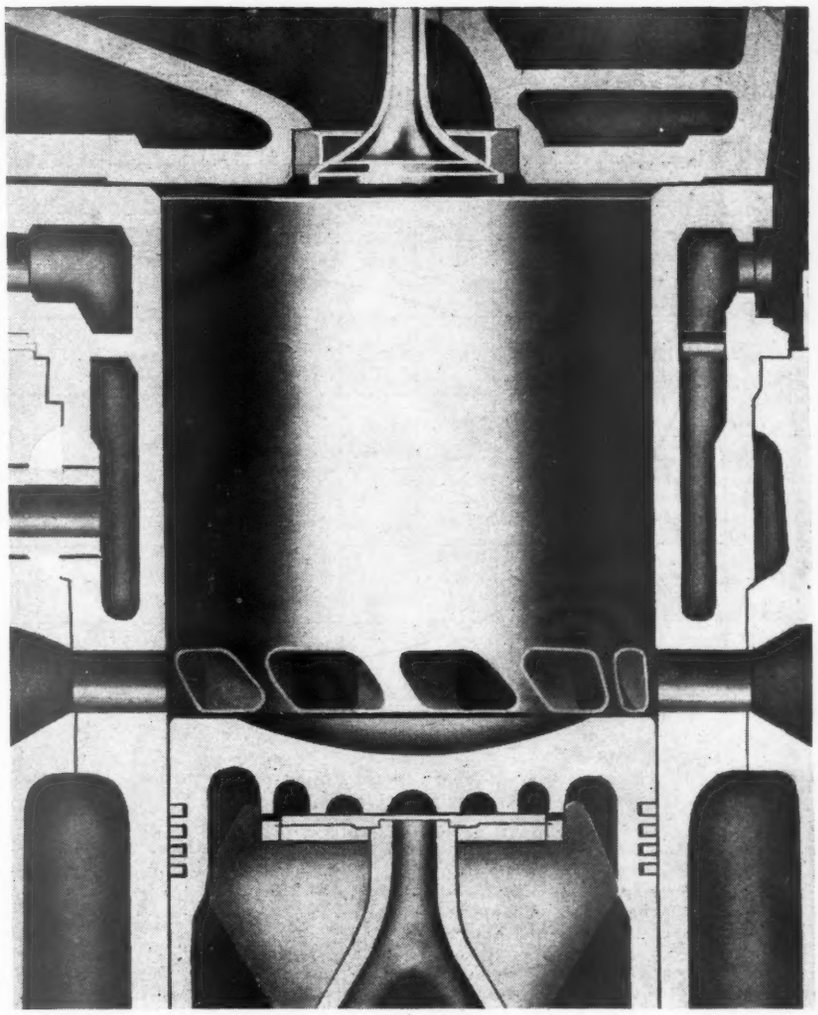


FIG. 2. Electrical schematic of automatic start and stop control circuit for three-unit 750-hp station.

PD_1, PD_2, B-B, RPD_2—Delayed shutdown of No. 2—300-hp unit on over-pressure (8-min delay).
PD_1, PD_2, B-B, RPD_2—Delayed shutdown of No. 1—150 hp unit on over-pressure (6-min delay).
R_2—Mechanical lock-out for No. 2 unit.
R_1—Mechanical lock-out for No. 1 unit.
P_x—Low pressure reset of mechanical latch-in relays R_1 and R_2 (reset on power failure).
Reset—Manual reset of mechanical latch-in relays R_1 and R_2.
Hi P, PR, and A-A—Immediate high pressure shutdown of all units (No. 3—300 hp, No. 2—300 hp, and No. 1—150 hp).
Reset—Manual reset of mechanical latch-in relay PR.
(R)—Red light indicating Hi P shutdown.
TS_2—Delayed start after power failure (3-min delay).
TS_1—Delayed start after power failure (15-min delay).
Transfer SW—Permits automatic starting of No. 1 unit if No. 2 unit shuts down when set for two-unit operation.
Note: Circuit conditions—no power, no pressure.

IT'S THE

Biggest News in Gas-Engine Compressors



The *vital power center*

that cuts down-time and increases efficiency in many gas and petroleum-processing services

For the first time, a vastly superior type of scavenging has been applied to compressor engines.

Worthington's timed scavenging system, built into the uniflo UTC-16, gives advantages far beyond any previous method.

A Thoroughgoing "Clean Sweep"

Here are some of the features of this new system concentrated in the "vital power center" illustrated above:

Complete removal of exhaust gas . . . more thorough charging with gas and air . . . positive timing for optimum combustion . . . effective supercharging . . . low operating temperature preventing carbonization . . . uniform cylinder temperature resulting in equal wall stress eliminating harmful stresses.

Many Uses . . . Many Sizes

While designed primarily as a pipeline gas-engine compressor, the UTC-16 is suitable for many other services, including: pressure maintenance on oil wells . . . in natural gasoline plants . . . in oil refineries, for solvent extraction, vapor recovery, recycling and stabilization of gases . . . in petrochemical processing of products made from natural gas under pressure . . . in many refrigeration applications.

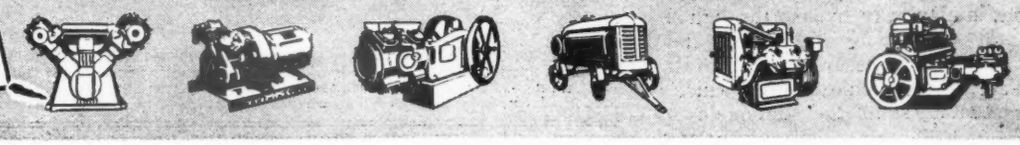
The Uniflo UTC-16 is built in sizes ranging from 800 to 2000 hp. For further proof that *there's more worth in Worthington*, contact our nearest Branch Office, or write the Worthington Pump and Machinery Corporation, Engine Division, Buffalo, N. Y.

WORTHINGTON

ENGINE COMPRESSORS

EK.1.2

NO OTHER COMPRESSOR WILL OUTPERFORM A WORTHINGTON



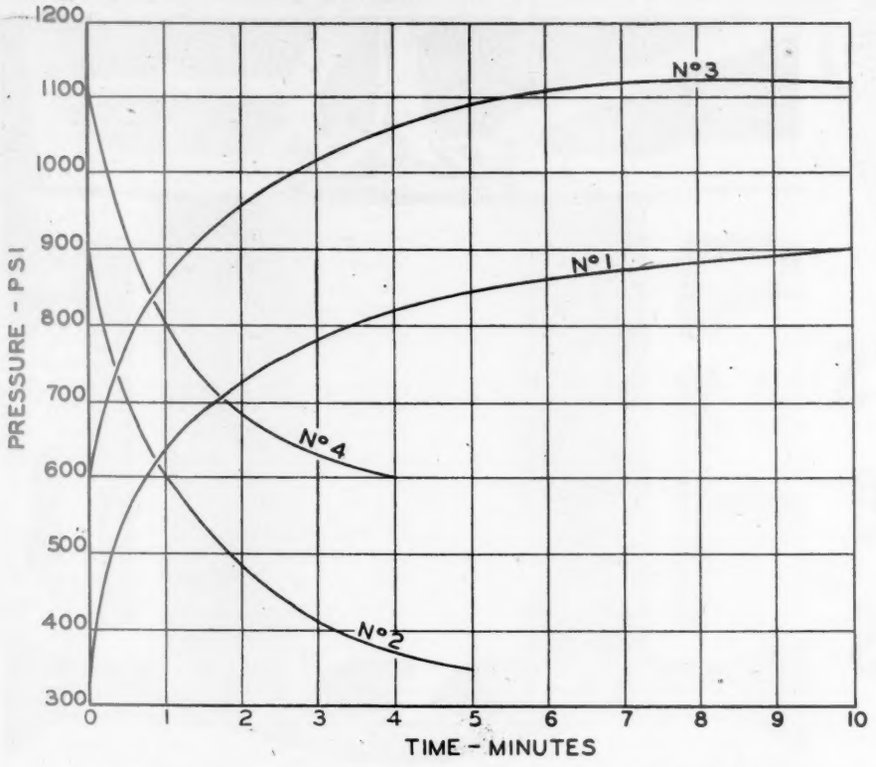


FIG. 3. Line pressure surges on reciprocating pumps starting with by-pass valve closed.

No. 1—Start 300-hp electric motor driven 125-rpm quintuplex pump (540 bbl per hr).
No. 2—Shut down same pump as above.
No. 3—Running No. 3—300-hp unit—start No. 2—300-hp unit.
No. 3—Running No. 3—300-hp unit—start No. 2—300-hp unit.
No. 4—Shut down same pump as above.
Note: Line fill total 16,500 bbl (50-mile 8-in. line).

are not nearly so steep as is commonly thought (see Fig. 3). Also, if "across the line" starters are used on electric motor driven units, the initial starting torque developed by the motor when the pump is started against a closed bypass should normally be only slightly higher than when starting against an open bypass. The 300-hp units shown in Fig. 2 start against a closed bypass and pressures as high as 800 psi with less than a 5 per cent increase in starting current (which lasts less than 5 sec) over starting with the bypass valve open.

2. *Shutdown sequence:* After the three units are operating at the originating station and both units are on line at the relay station, the same shutdown mercoids and time delay relays are actuated to shut the units down at the originating station in sequence (No. 1 first, then No. 2) to balance out pumping conditions as dictated by the number of units in operation at the relay station. For example, if trouble develops and shuts down either of the two units at the relay station, the No. 1 unit at the originating station will automatically be shut down, leaving the No. 3 and No. 2 units at the originating station on line with one unit at the relay station.

Each reciprocating pump at the originating station may bypass through a relief valve that opens at 1150 psi, and a 1275-psi high pressure mercoid (Hi P) is across the whole station, which, when actuated, shuts the station down and requires a manual reset before any unit can be put back on line. Both of the shutdown time delays (RPD_1 and RPD_2) on the No. 1 and No. 2 units at the originating station operate other relays of the mechanical latch type, which prevents the No. 1 or No. 2 units from coming back on and "cycling" after either unit is once shut down. They must either be manually reset, or reset by the P_x mercoid, which is actuated in the case of a power failure when the line pressure drops to the static hill pressure —260 psi. Therefore, if a power failure occurs at the originating station and the line pressure drops to 260 psi, all units set for automatic operation will come back on line in their proper sequence.

Table 1 gives the starting and shutdown sequence of both the originating and relay stations, which will automatically function as indicated.

B. Relay station operation (see Fig. 4). The relay station on this line has considerably more control equipment installed than the originating station, as its operation is controlled by the originating station and provisions must be made for other problems arising from the use of high speed multi-stage centrifugal pumps. The pattern of operation of this station is described as follows:

1. *Starting:*

a. After the No. 3 and No. 2 units are running at the originating station and the bypass pressure at the relay station reaches 430 psi, the starting mercoid on the No. 1 unit (PS_1) trips, which energizes the opening circuit on the motorized suction valve on the No. 1 unit. When the No. 1 suction valve is completely open (after 65 sec), limit switch contacts complete the starting circuit on the No. 1 unit and it comes on line.

b. After the No. 1, No. 2, and No. 3 units are running at the originating station with the No. 1 unit running at the relay station and the relay station discharge pressure reaches 760 psi, the No. 2 starting mercoid (PS_2) trips, which energizes the opening circuit on the No. 2 motorized suction valve, and the No. 2 unit comes on line when the suction motor valve is completely open.

2. *Shutdown:* If the No. 1 unit at the originating station is shut down, as soon as the pressure at the relay station drops to 670 psi the shutdown mercoid PD_2 trips, energizing the closing circuit on the No. 2 motor valve, which shuts the No. 2 unit down with limit switches as soon as the valve starts to close. If the No. 2 unit at the originating station is shut down, the No. 1 shutdown mercoid PD_1 trips, which results in shutting down the No. 1 unit when the pressure reaches 340 psi. As the closing circuit on the respective suction motorized valve is energized by a shutdown pressure mercoid, the valve completely closes and locks out the unit starting circuit until it becomes automatically reset by the pressure starting mercoids. Thus, the relay station bypass pressure

Table 1. Automatically controlled pumping conditions

Originating station pumping condition	Capacity, bbl per hr	Remarks	Relay station pumping condition	Remarks
Start:				
No. 3-300 hp	540	No. 3 starts immediately after the power is restored.	.....	Relay station bypassed
No. 3-300 hp No. 2-300 hp	1080	No. 2 starts 3 min after the power is restored.	No. 1-400 hp	No. 1 unit starts 1 min after line pressure reaches 430 psi.
No. 3-300 hp No. 2-300 hp No. 1-150 hp	1410	No. 1 starts 15 min after the power is restored.	No. 1-400 hp No. 2-400 hp	No. 2 unit starts 1 min after discharge pressure reaches 760 psi.
Shutdown:				
No. 3-300 hp No. 2-300 hp	1080	No. 1 shuts down 6 min after pressure reaches 1150 psi.	No. 1-400 hp	No. 2 unit goes down when discharge pressure reaches 670 psi.
No. 3-300 hp	540	No. 2 shuts down 8 min after pressure reaches 1150 psi.	.....	No. 1 unit goes down when discharge pressure reaches 340 psi.

Note: If originating station is set for two-unit operation (No. 3 and No. 2 units), and the No. 2 unit goes down due to high pressure, a transfer switch permits the No. 1 unit to start immediately and results in a total throughput of 870 bbl per hr.

All starters have a three-position selector switch — hand, off, and automatic. When the selector switch is in the hand position, all controls are taken out of the starting circuit with the exception of the high pressure mercoid across the whole station

Here's a blueprint FOR INCREASING SPEED AND REDUCING WORRY

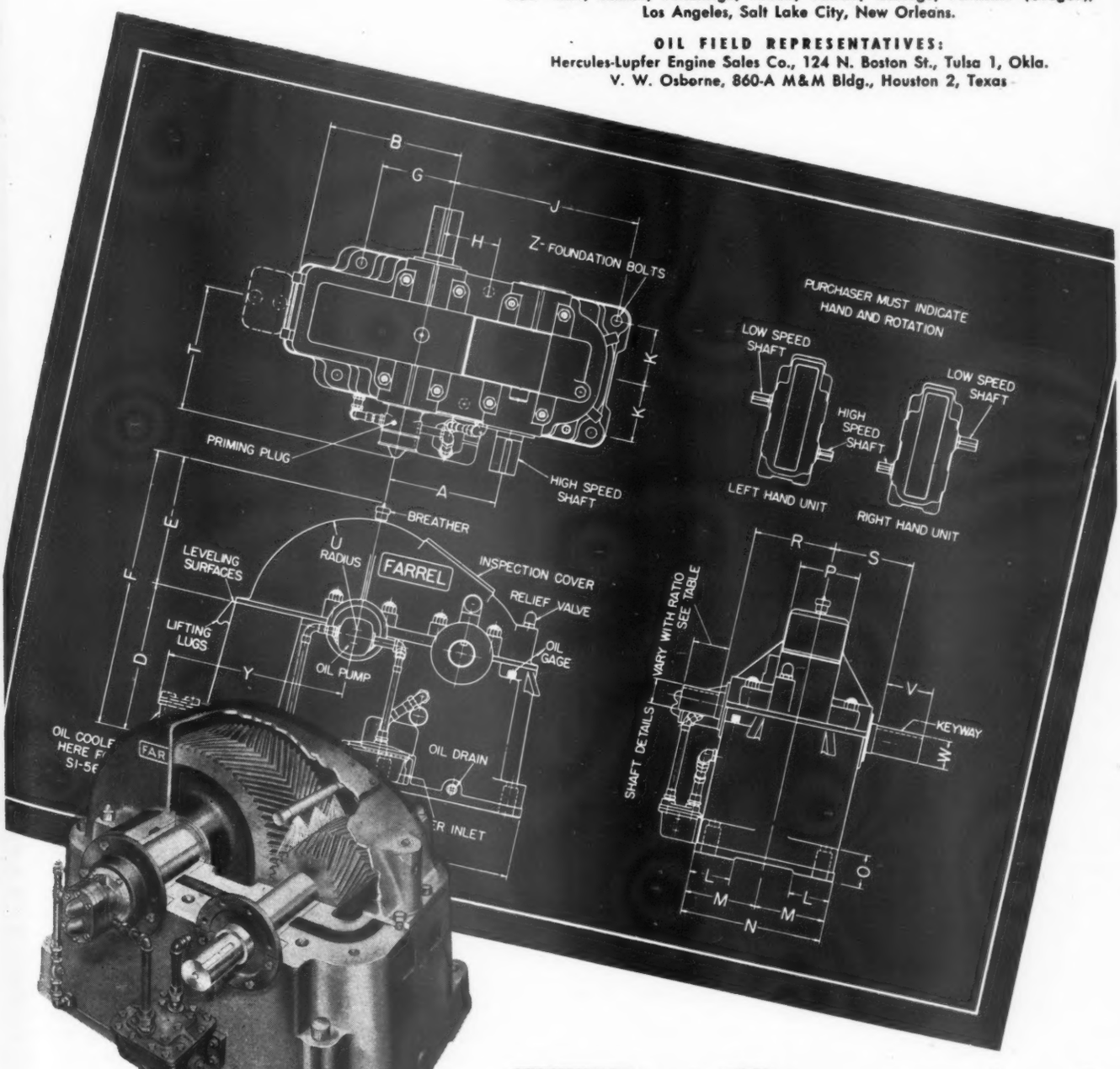
In 1932, Farrel developed a series of speed increasers which has taken at least some of the worry out of pipeline pumping station operation. For, of the hundreds of units installed in the oil industry since then, ***not a single one has ever failed in service.***

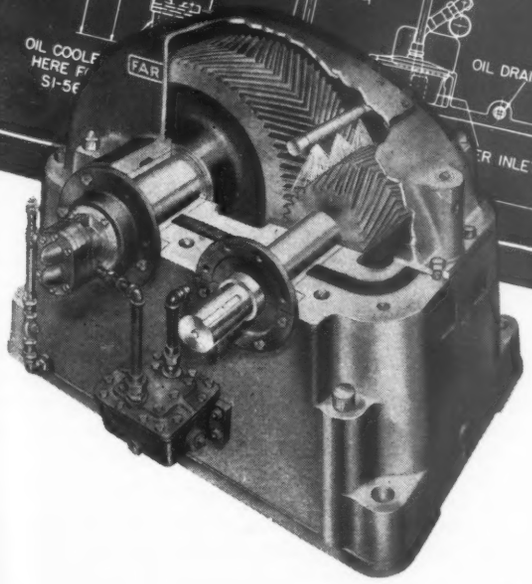
In view of this exceptional twenty-year record, you can feel confident that your own worries will be reduced when you specify *Farrel speed increasers.* These units are available in 49 standard sizes, with speed ratios ranging from 1:1 to 12:1. For higher ratios, units using two sets of gears are supplied with ratio range from 12:1 to 40:1.

For further information about these service-proved speed increasers, write for your copy of Bulletin No. 448A. No cost or obligation.

FARREL-BIRMINGHAM COMPANY, INC., ANSONIA, CONN.
Plants: Ansonia and Derby, Conn., Buffalo, N. Y. *Sales Offices:* Ansonia, Buffalo, New York, Boston, Pittsburgh, Akron, Detroit, Chicago, Portland (Oregon), Los Angeles, Salt Lake City, New Orleans.

OIL FIELD REPRESENTATIVES:
Hercules-Lupfer Engine Sales Co., 124 N. Boston St., Tulsa 1, Okla.
V. W. Osborne, 860-A M&M Bldg., Houston 2, Texas





Farrel-Birmingham ®

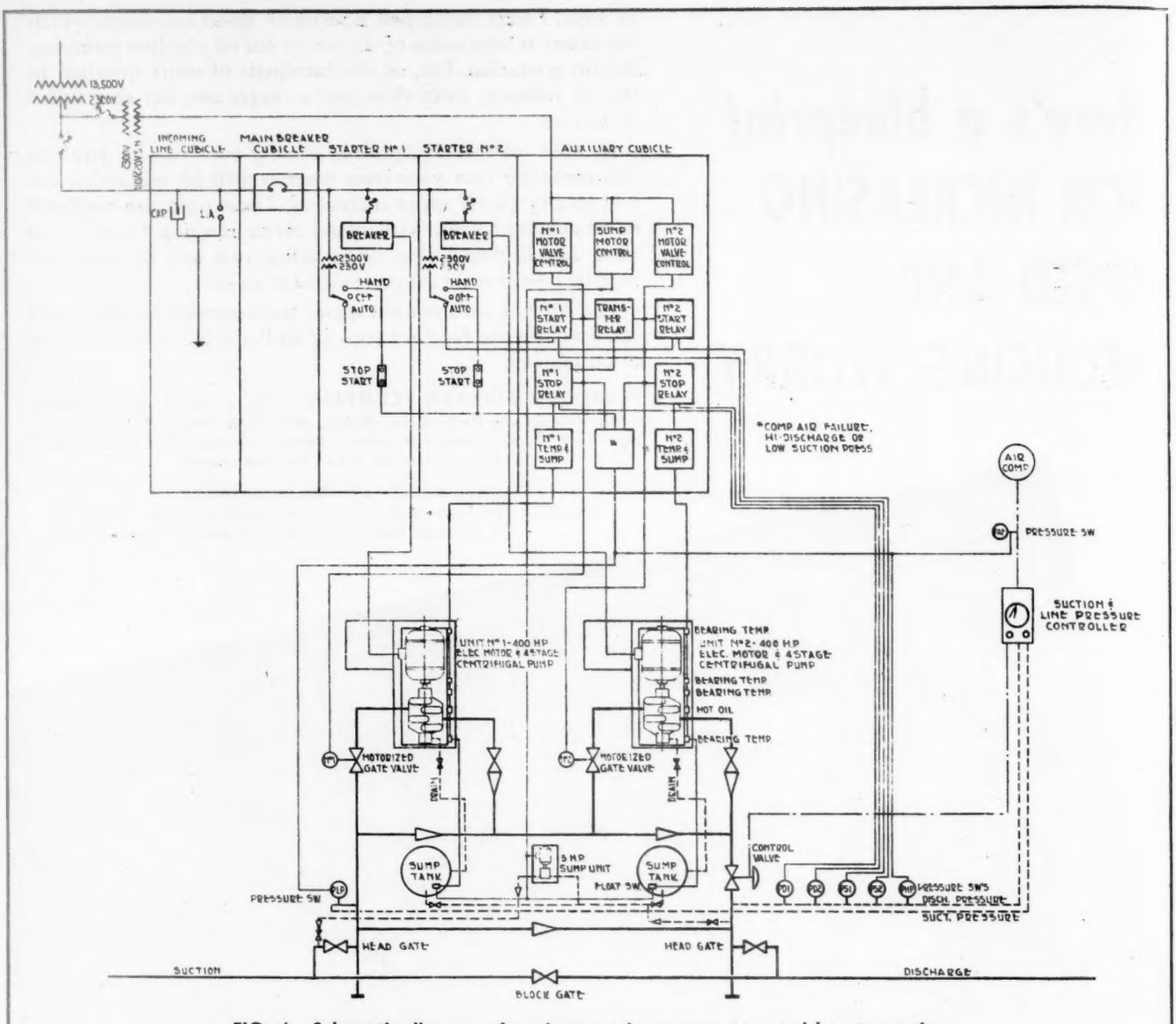


FIG. 4. Schematic diagram of semi-automatic pressure-operated booster station.

is sealed off from the pump packing when the pump is not in operation.

3. *Protective controls:* There are also other protective shutdown devices, which include:

a. High pressure mercoid shutdown set at 1200 psi across the whole station, which requires a manual reset (for protection against a blocked discharge line).

b. Low suction pressure mercoid shutdown set at 15 psi across the whole station, which requires a manual reset.

c. High temperature bearing relay shutdowns (requiring manual reset) on each motor bearing (180 F setting), each pump bearing (155 F setting), and in each pump case (120 F setting), which will shut each unit down individually.

d. A control air failure shutdown across the whole station to protect against an excessive air leak or air compressor failure, which would result in the pneumatically operated control valve becoming inoperative.

e. Individual unit 3-bbl capacity sump tanks equipped with three-position float switches are installed to take packing leakage from each pump. As packing leakage fills a sump up to the first level, a float switch starts the sump pump (common to both tanks), which discharges into the suction side of the station. If leakage is in excess of the sump pump capacity and the sump continues to fill, a higher level float switch will energize the motor valve closing circuit, which will result in the respective main unit being shut down and the isolating motor valve closed. When the sump is emptied down to a low level, a float switch is actuated to shut the sump pump down.

A Foxboro Stabilog pressure controller is installed at this station to control the suction pressure above a minimum of 50 psi and the discharge pressure below a maximum of 1175 psi by supplying controlled air to operate an "air to open" Fisher balanced throttle plug diaphragm control valve set in the discharge line. Under normal automatic operation, the centrifugal units at the relay station start against a fully open discharge gate and run balanced against the line with no throttling loss.

Normally, the No. 1 unit is on low pressure controls and the No. 2 unit is on high pressure controls. In the event that the No. 1 unit becomes inoperative due to a mechanical failure and is shut down, a transfer relay automatically switches the No. 1 low pressure controls to the No. 2 unit, locks out the high pressure controls, and allows the No. 2 unit to start or continue to run on the low pressure controls. After the trouble is remedied, a manual reset then places the station back in normal operation.

Hand, off, and automatic selector switches are provided on each starter. The hand position cuts out all controls except the high discharge, low suction, and air failure pressure actuated mercoids across the whole station.

Conclusion

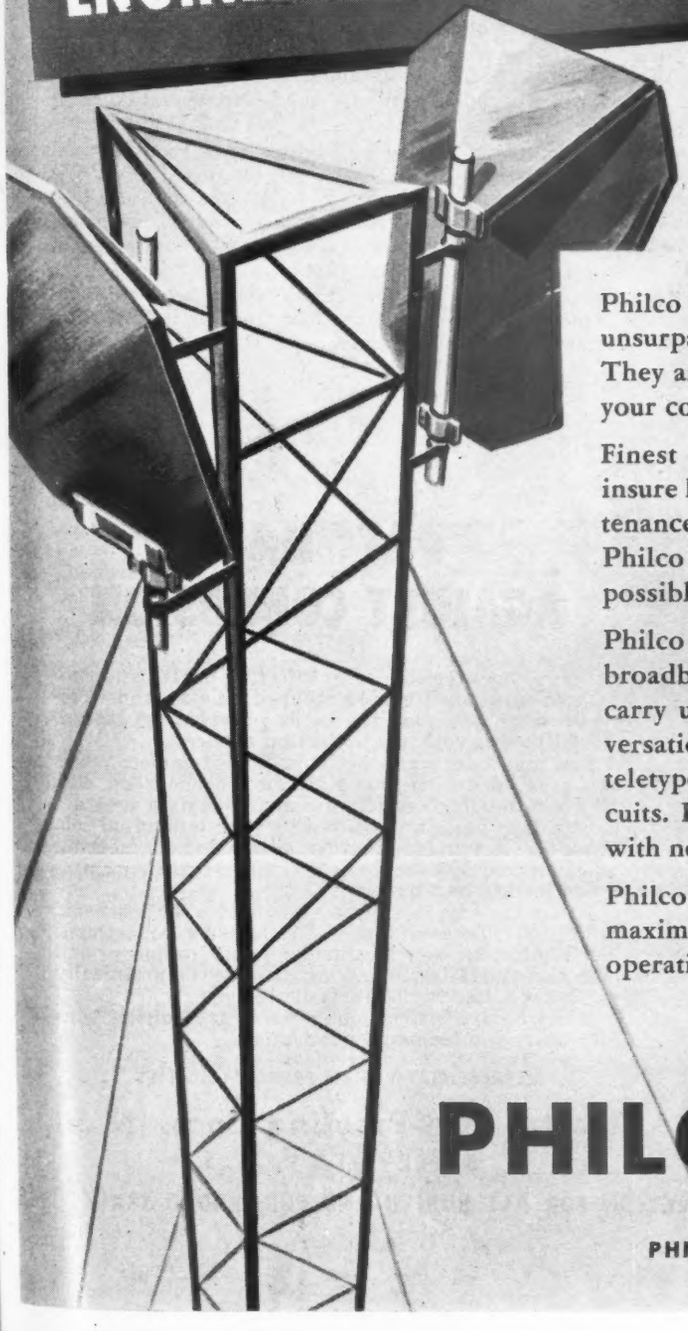
The potential reduction in direct operating costs through the use of control equipment and normally unattended sta-

PHILCO

Advanced Design MICROWAVE

COMMUNICATIONS SYSTEMS

ENGINEERED FOR GREATEST ECONOMY!



Philco *Advanced Design* Microwave Systems are unsurpassed in reliability, performance and economy. They are designed to give you the greatest value for your communications dollar!

Finest quality components, conservatively rated, insure long life and economy of operation and maintenance. Years of production experience enable Philco to produce microwave systems for the lowest possible cost consistent with highest quality.

Philco *Advanced Design* Microwave is flexible. The broadband microwave channel may be divided to carry up to 24 simultaneous 2-way telephone conversations . . . or be further divided for telegraph, teletype, telemetering, signaling or supervisory circuits. Future expansion can be easily accomplished with no loss of original investment.

Philco *Advanced Design* Microwave Systems give you maximum reliability . . . plus *low cost* installation, operation and maintenance. *Don't settle for Less!*

PHILCO CORPORATION

INDUSTRIAL DIVISION

PHILADELPHIA 34, PENNSYLVANIA

tion operation becomes apparent when specific cases are evaluated. The direct operating labor costs to man both of the two previously discussed stations under different conditions give the following comparison:

A. Each station manned continuously by a station engineer and supervised by a chief station engineer, $50,000 per year.

B. Each station manned continuously by a station engineer only, $38,200 per year.

C. Each station attended by a gager an average of four hours daily, $6,900 per year.

Note: The installed cost of the additional control equipment necessary for normally unattended operation at both stations was approximately $4000.

The advantages of modern control equipment are accepted facts. Their successful application to specific installations is governed by correct use and the cost involved as compared to results obtainable. The controls considered necessary to provide for normally unattended station operation are of primary importance; however, the progressive attitude of the operating management toward a trend to decentralize responsibility to the controls and periodic qualified supervision is of utmost importance for the successful promotion and future development of field control equipment. Established precedents and practices in providing attendant manpower, both for the purpose of operating convenience and relieving abnormal situations, must be evaluated in each case for actual need versus the manpower costs involved. Where attendance is provided in excess of that required, the extra manpower supplied is not only costly and unproductive, but creates a laxity in the attendant employee whose efforts are not spent constructively.

One of the most important phases in the successful use of pipe line control equipment is in the education of the personnel who will be associated or concerned with the control operation. This education should include the reasons for the installation, the results that are to be accomplished, the design and operation of the equipment, and the contingencies that are provided for in case of control equipment failure. When the field operators understand and approve the control application, the stimulated interest resulting from a better understanding of the operating procedures directly benefits both the personnel involved and the company as a whole.

It would be out of line to advocate pipe line control equipment as a "cure all" for inefficient operation, excessive labor costs, and lack of closely coordinated operating control. There is much to be said, however, for the potentialities that exist today, and if future technical developments in control equipment application keep in step with good field operating practices, the forthcoming improvements will competitively force many refinements to be made in pipe line operating techniques. * * *

Reinforce your pipe coatings with Vitron

UNDERGROUND PIPE WRAP

An outstanding reinforcement that has helped form high-dielectric coatings on thousands of miles of pipelines, Vitron Underground Pipe Wrap gives you these time-saving, cost-saving advantages—

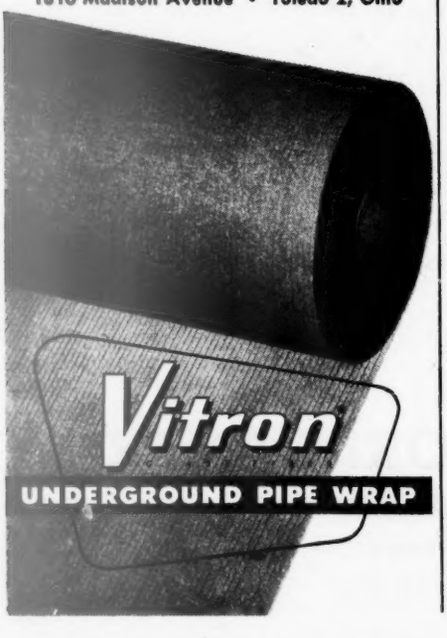
Higher Coating and Wrapping Speeds. VITRON Underground Pipe Wrap is extra-reinforced with parallel strands of high strength glass yarn.

Fewer Holidays. Uniform porosity gives even bleed-through of coating compound, allows holiday-forming gases to escape.

Greater Permanence. VITRON Underground Pipe Wrap will not rot or weaken under fungus or bacterial attack. It resists soil acids, absorbs no moisture.

Write for samples and descriptive engineering material.

GLASS FIBERS INC.
1810 Madison Avenue • Toledo 2, Ohio



"PAT" HAND AGAINST CORROSION

Corrosion losses affecting buried and submerged structures can be stopped quickly and effectively when you play the cards provided by Electro Rust-Proofing cathodic protection service.

For pipe lines, tank bottoms, buried cables, water tanks, off-shore drilling platforms, condensers, etc., ERP engineering services are available on a contract or per diem basis as required by each individual job. These services include surveys, design and engineering all conducted by capable field engineers utilizing precision testing instruments.

Where the engineering work indicates that cathodic protection is necessary, the ERP Contract Department is ready to take over the furnishing of equipment and materials, installation and maintenance on practically any basis suited to the needs of the job.

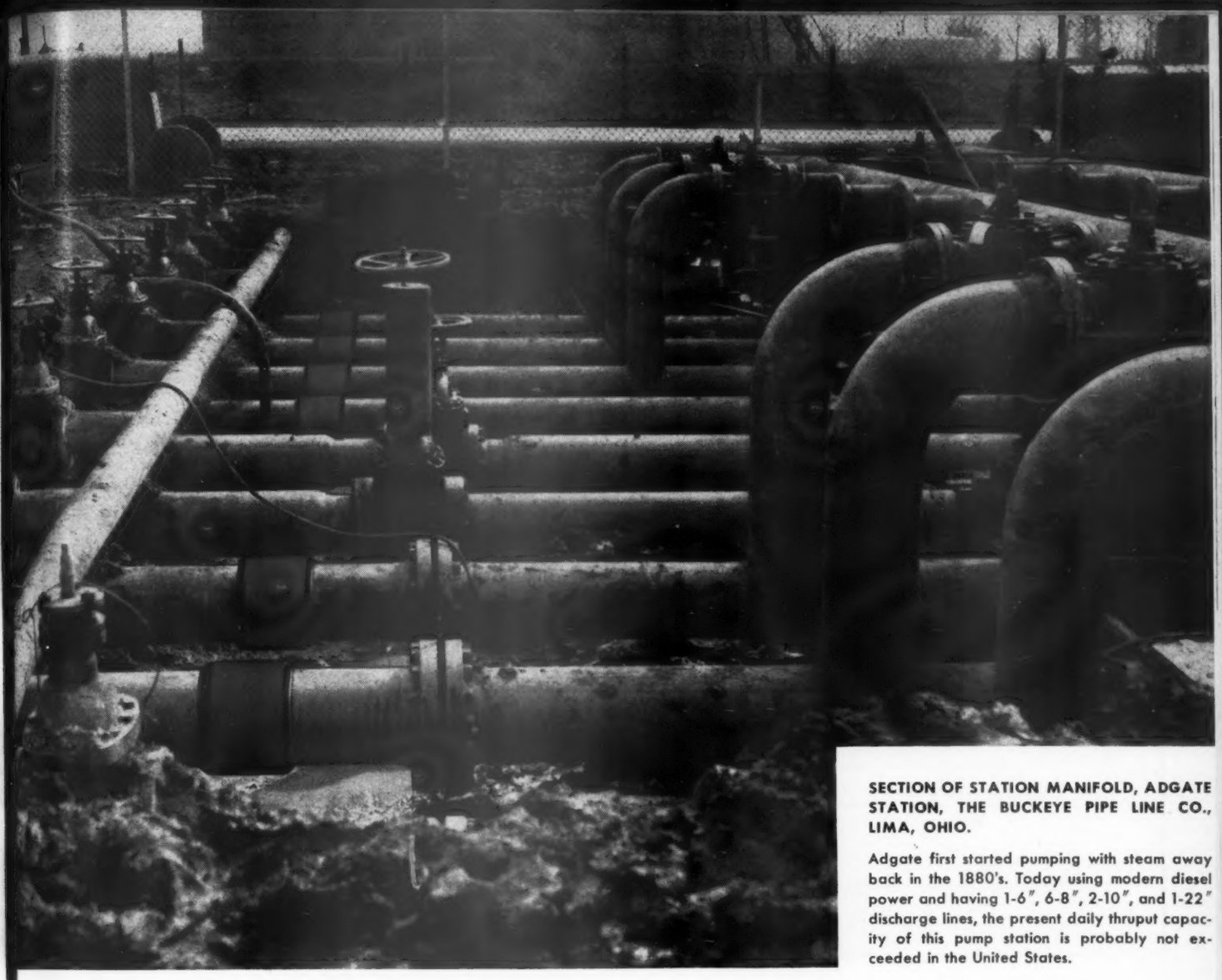
Write today, without obligation, for additional information and technical publications.

REPRESENTATIVES IN PRINCIPAL CITIES

Electro Rust-Proofing Corp. (N. J.)
BELLEVILLE 9, N. J.

E-18

CATHODIC PROTECTION FOR ALL BURIED AND SUBMERGED STRUCTURES



SECTION OF STATION MANIFOLD, ADGATE STATION, THE BUCKEYE PIPE LINE CO., LIMA, OHIO.

Adgate first started pumping with steam away back in the 1880's. Today using modern diesel power and having 1-6″, 6-8″, 2-10″, and 1-22″ discharge lines, the present daily thruput capacity of this pump station is probably not exceeded in the United States.

WELD + ENDS = SAFETY + SPEED + ECONOMY

Better be safe than sorry — use them always.

- They provide the safest, quickest, and most economical means for rejoining crude oil, gas and products pipelines.
- They securely rejoin pipeline so flow can be resumed immediately, *even before welding.*
- They save shutdown time and costs.
- They reduce maintenance labor and overtime costs.
- They reduce line drainage time and losses.
- Eliminate mud and rubber plugging.
- Eliminate "hot" tie-ins on gas lines.
- Eliminate steaming-out refinery lines.

On this Job —

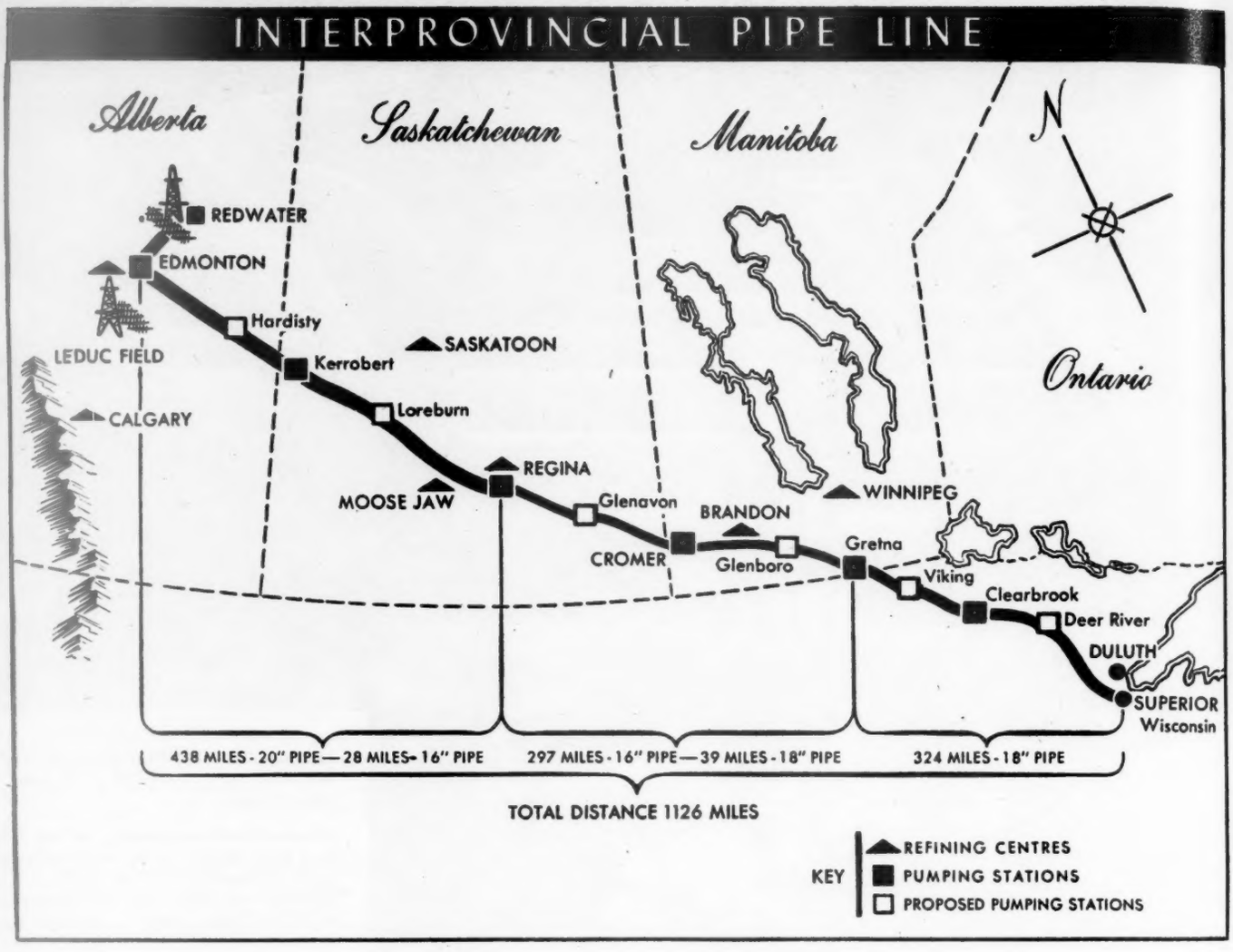
1. New piping sections were prefabricated in a weld-safe area.
2. Old pipe sections were cut out and the new prefabricated pieces were lowered into place.
3. They were connected into the piping system with WELD+ENDS couplings, (one end only shows in this view).
4. All couplings were tightened securely and full pressure oil flow was immediately resumed.
5. Clean-up of oil hazards and welding then went ahead at an economical as well as at a safe and sane pace; requiring several days, but without once interrupting full capacity oil flow.

THOUSANDS OF DOLLARS INVOLVING SAFETY ASSURANCE, PIPELINE DOWNTIME, LABOR, AND OVERTIME, WERE SAVED ON THIS JOB!

Write for further information and learn how to work Safer, Faster and more economically with WELD + ENDS.

PIPE LINE DEVELOPMENT COMPANY

2536 EUCLID AVENUE • CLEVELAND 15, OHIO



COLD WEATHER PIPELINING

Unusual operating problems on Interprovincial system are due to the severe winter conditions

T. S. JOHNSTON*

Abstract

Interprovincial Pipe Line Company has recently completed 1126 miles of larger-diameter pipe line, extending from the newly discovered oil fields in western Canada (Redwater, Alberta) to Superior, Wisconsin. From Superior the crude oil is transported by tankers on the Great Lakes to markets in Ontario.

Interprovincial has several unique features not generally found in other pipe lines—among them being the construction and operating problems in the country through which the line passes, where most severe winter conditions are encountered. The story of Interprovincial is told in this paper, and is supplemented by a motion picture that shows construction of the line.

Spur to Industrial Activity

The Interprovincial Pipe Line Company and its American subsidiary, Lakehead Pipe Line Company, Inc., were born in the same way as practically all crude oil pipe lines are born, i.e., the result of newly discovered crude attempting to find its way to a more distant market. The discovery of oil in northern Alberta in 1947 was an event of extreme importance both to Canada and to the Western Hemisphere. The effect of this discovery on the Canadian economy was not only most interesting, but actually remarkable for the speed at which this change was felt. By the prompt reduction of American imported crude considerable strain was removed from the government to furnish U. S. dollars at a time when the supply was

†Presented before American Petroleum Institute, Division of Transportation, November 6, 1951, Chicago, Illinois.

*President, Interprovincial Pipe Line Company, Toronto, Canada.

MIDWESTERN *for All Three*

COROMAT *Inner Wrap*

COROMAT Inner Wrap, manufactured by Owens-Corning and distributed by Midwestern, is engineered specifically for pipe line enamel reinforcement. Coromat is inert and inorganic. It is dimensionally stable—won't sag, stretch, or shrink. The parallel reinforcing plus the uniformly fine fibers and high porosity of Coromat assures complete impregnation and uniform bleed-through of the coating during application. Exhaustive field and laboratory tests have proven over the years that the use of Fiberglas Coromat retards cold flow of the coating and guards against cracking of the enamels at low temperatures. Midwestern offers Coromat in rolls of 400, 800, 1000 and 1200 feet lengths.

PIPELINE OUTER WRAP

FIBERGLAS OUTER WRAP is a strong corrosion resistant material especially designed to act as an exterior protection for underground pipe lines. The material possesses exceptional strength and wrapping characteristics. It readily conforms to the pipe, fitting smoothly and tightly on bends. Fiberglas Outer Wrap is designed to have ample porosity to permit complete release of trapped gasses and air. The moisture absorbtion of this Outer Wrap is less than ½ of 1% and it will not wick out the lighter fractions of the bitumen or permit moisture to be drawn from the coating. Fiberglas Outer Wrap will withstand storage temperatures from 0° to 150°F. without deterioration.

KAPCO ROCK SHIELD

For that FINAL pipe line protection Midwestern offers KAPCO ROCK SHIELD, a mastic composition board which eliminates damage in rocky areas. Rock Shield sheets are easily formed around the pipe and are held in place by either metal strapping or high tensile tape. Kapco Rock Shield completely eliminates the trouble and expense of dirt padding. No tractors, bulldozers or dump-trucks are needed when Rock Shield is used on the pipe. Scientific penetration tests have PROVEN Kapco Rock Shield effectiveness in eliminating holidays formerly caused by rock damage. The board has also proved highly effective at river and road crossings and elsewhere where pipe and coating are subject to rough handling.

Manufactured by Keystone Asphalt Products, a division of American-Marietta.

A COMPLETE CORROSION PROTECTION SERVICE!

WRITE FOR PRICE LISTS AND SPECIFICATIONS TODAY!

MIDWESTERN ENGINE & EQUIPMENT CO., INC.

105 N. Boulder, 15 S.W. 29th St. — TULSA, OKLAHOMA, OKLAHOMA CITY, OKLAHOMA — Phone 3-4113, Phone 2-2527

HOUSTON, TEX. — D. E. HUGHES — 5030 Arvilla Lane — Olive 1095

PITTSBURGH, PA. — JOHN R. WILSON — 555 McCulley, McKeesport, Pa. — McK 2-5461

SHREVEPORT, LA — TOM L. HOLCOMBE — Box 1306, Shreveport — 7-0584

ATLANTA, GA — RAYMOND TRAPP — 3431 Sherman Rd., Hapeville, Ga. — Calhoun 7929

not too adequate. This was only the start of a period of increased industrial activity in western Canada: i.e., as the further oil discoveries continued to back out American crude, more U. S. dollars were saved; additional refining capacity has been built; foreign capital has come into Canada on a large scale; and business generally has been stimulated by the increased demands from many industries.

Haste of the Essence

It was not too long after the Leduc discovery that the Redwater field came into the picture, and this was followed in fairly close order by Golden Spike and others—all in the Edmonton area. As the proved reserves built up, it was apparent that supply would exceed the demand in the prairies, and at that point discussion started on the possibility of a pipe line to the East.

The very early thinking on this pipe line contemplated construction only as far as Regina, a distance of about 450 miles. However, in view of the fact that the rapid increase of reserves in Alberta justified a wider market, it was decided to carry the line through to the lake head in one step. This decision was made early in 1949—less than 2 years after the original oil discovery at Leduc. Naturally many problems immediately arose. Steel and materials in general were very scarce; and, as the entire route through which the pipe line would be laid experienced extremely cold winters, the only economical and practical method of construction appeared to be to attempt the entire program during the summer months of 1950. This meant that 1126 miles of line—together with 6 pump stations, as well as terminal facilities and 1,800,000 bbl of storage—would have to be completed in 150 days.

This schedule called for the design and engineering to be carried out with as much haste as possible so that orders could be placed with various manufacturers for equipment and pipe. As Imperial Oil, Ltd., was the largest producer of western Canadian crude, this company sponsored the early organization of Interprovincial. It provided the original management, assisted in procuring adequate personnel, and handled the voluminous work entailed in ordering materials and making the necessary purchasing arrangements. As matters stand today, Imperial owns about 33 per cent of Interprovincial.

The Interprovincial system starts at the Redwater field, just north of Edmonton, Alberta (see map in Fig. 1).

It will be observed that in Canada the system crosses three prairie provinces, viz., Alberta, Saskatchewan, and Manitoba. It extends down into the United States through North Dakota, Minnesota, and Wisconsin; and terminates at Superior—a total distance of 1126 miles.

A New Venture

It should be remembered that pipe lines, as far as Canada was concerned, were an entirely new venture, and the public had not been educated to the point where they accepted this mode of transportation to the degree that exists here in the United States. Consequently, obtaining the right-of-way and the controversies that arose over the route of the line was to take became something of a public relations matter. It required an extensive program to explain our project to hundreds of prairie landowners, as well as to various communities.

Furthermore, there was no legislation in Canada that specifically dealt with pipe lines. It fortunately developed that this was not too much of a problem because the reception of our program by the Canadian government was most favorable and, to some extent, we were able to offer suggestions on the type of legislation. We hoped that the regulations would stem from the federal government rather than from the provinces, as in the latter case we would probably be faced with different laws in the three provinces.

To get the work started promptly, a small engineering office was established with a very limited personnel. Gradually more staff was added as we were able to pick up experienced people and they were able to carry the work to the point where there were sufficient data available to ask for bids from contractors. This was towards the end of 1949.

ROSKOTE cold-applied anti-corrosion mastic saves time...saves money...SAVES PIPE!

Roskote's drying speed, its handling ease and its high electrical resistivity makes it the ideal mastic for pipeline protection, winter or summer. Whether you are protecting distribution and service lines, or large transmission lines in yard or field, it will pay you to investigate . . .

ROSKOTE cuts field costs because it is applied COLD — either brush, spray or special line-traveling machine — without primer or field mixing. It eliminates labor, equipment and hazards of hot-applied materials. It is fast-setting to a tough, flexible film of high electrical resistivity (20 megohms per sq. ft.) without brittleness or sag through a temperature range of −40° to 375°F. It dries to the touch in 20 minutes and is ready for backfill in an hour.

Roskote's resin base resists acids, alkalies, salts and moisture. It bonds readily to previous coatings of coal tar or asphalt. Wire brushing is the only preparation needed for old pipe.

Roskote's drying speed and handling ease cuts man-hours from work schedules and speeds pipe-line progress. That saves real money! Yet Roskote costs only 3¢ per square foot of coverage.

Used by over 70 utilities and pipeline companies for coating at "hot spots," road crossings, for valves, joints, meters, drips; for patching and for waterproofing concrete regulator pits.

•

Write for bulletin containing complete technical specifications, chemical and electrical properties and application information. Ask for the Roskote special trial order offer.

ROYSTON
LABORATORIES, INC.,
BLAWNOX, PA.

MANUFACTURERS OF QUALITY INDUSTRIAL COATINGS RESISTANT TO CORROSION BY ACIDS, ALKALIES, ELECTROLYSIS, HEAT, MOISTURE AND WEATHER.

30 digging feeds range from 18½ to 585 lineal ft. trench per hour.

Wide work range. . . Model 250 digs 16 to 42" wide at 12'-6" depth.

15 cutting widths are available with only 4 standard size buckets, side cutters and oversize teeth.

Replaceable tooth points . . quickly installed, self-sharpening, get full bucket load every bite.

Alloy and heat-treated steels in bucket chains keep maintenance low.

Telescopic boom locks at 12" intervals for quick depth changes.

Reversible conveyor shifts by power through machine in 1 minute.

Friction clutches control digging, boom hoist, steering, traction, engine.

Automatic safety clutch protects all machinery from shock loads.

Low center of gravity assures safe Trenchliner operation for work and travel over uneven terrain.

Tractor-type,self-cleaning crawlers have 7 lbs. PSI pressure.

Fully-enclosed gears in constant oil bath assure steady, trouble-free operation with 250 Trenchliner.

Call your Parsons distributor now for more complete information on this heavy-duty 250 Trenchliner, or for facts on all other Parsons models.

PARSONS CO., Newton, Iowa

PI30

PARSONS HEAVY DUTY KRING PRODUCT

PARSONS *Trenchliners*®

KOEHING SUBSIDIARY

Canadian-American Project

Inasmuch as no Canadian contractors had sufficient experience in the pipe line field to take on a job of this magnitude, it was necessary to bring in competent American pipeliners. It was the intention to have three prime contractors, each taking approximately one-third of the entire line and each working independently, handling one size of pipe. We have 20-in. from Edmonton to Regina, 16-in. from Regina to the border, and 18-in. on the American section. As Interprovincial was a Canadian venture, it was desirable that Canadian labor and materials of Canadian origin be used to the greatest extent possible. It was difficult to adhere to this policy; but, for the most part, the results were better than originally had been anticipated.

Construction Difficulties

The availability of materials was the problem that caused us the greatest uneasiness. As previously mentioned, steel at that time was in short supply, and line pipe of the size desired was something that had not been manufactured in Canada. After considerable negotiation with steel manufacturers and pipe fabricators in Canada, a new pipe mill was constructed that turned out 16-in. pipe for our line. The other 2 sizes, viz., 18-in. and 20-in, were obtained in the United States. To effect our construction program and to have the work started as early as possible in the spring of 1950, large quantities of this pipe were fabricated during the preceding winter and shipped to rail points adjacent to the right-of-way. The pipe was stockpiled and moved to the right-of-way and strung during the time the ground was frozen hard.

Prime contractors were requested to move in their equipment on the frozen prairies during the winter of 1949-50 with the intention that they would be able to start operations as soon as the ground was workable. This turned out well with the exception of the area in Manitoba, where an extensive flood throughout the Red River Valley made the ground impassable until May and June. Other spreads to the west were well on their way by this time.

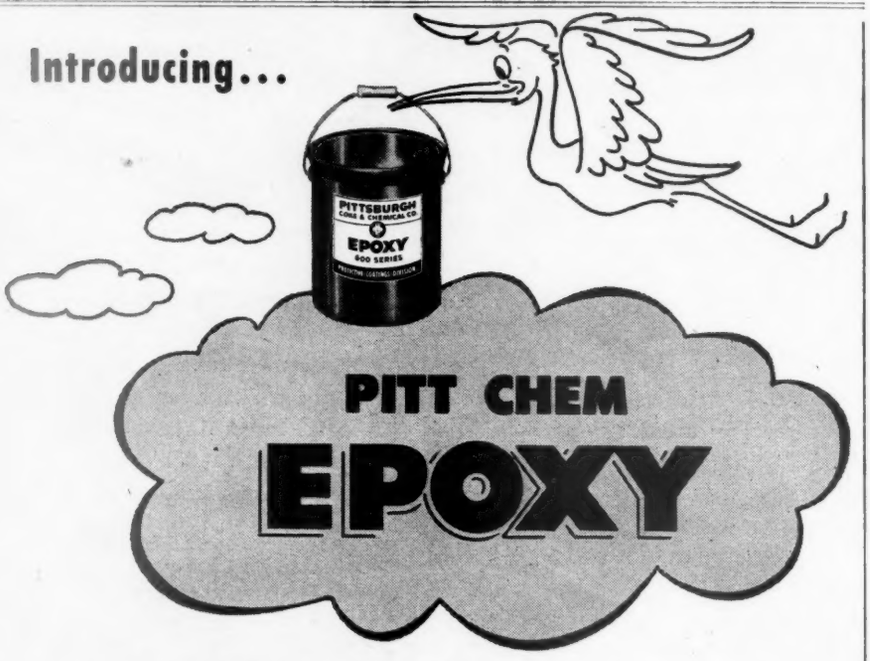
On the American section, the Minnesota swamps provided difficult going; the spring of 1950 was one of the wettest on record. However, as the summer progressed and the weather became hotter, the spreads began to make up for lost time. Across the prairie remarkable progress was made.

The work of picking up right-of-way began late in 1949 and continued throughout the winter and on into the actual construction period. The winter work was extremely difficult, as it meant traveling on country roads that, for the most part, were blocked with snow. Temperatures well below zero were the common occurrence and snowmobiles and shovels were the equipment that the landmen had at hand most of the time. In all, some 2000 landowners were contacted over the entire route of the line.

Unique Storage Facilities

This pipe line, operating as it does in the northern areas, is somewhat unique in the amount of storage that is required at its terminal in Superior, Wisconsin. Inasmuch as the greater part of the system's throughput is destined for refineries in Ontario by tanker movement, the problem of storing crude from December to April becomes an expensive one. Navigation on the Great Lakes is at a standstill for these four months; therefore, line throughputs are reduced during that period to provide only sufficient crude to fill the available storage, plus relatively small deliveries that are made locally. Superior had at the start twelve 150,000-bbl tanks, and that investment was to be only the beginning.

At the western end of the line, viz., at Edmonton, there are at present 6 storage tanks, with a total capacity of 840,000 bbl, in which crude is accumulated before it starts its movement eastward. Further along the line Interprovincial has breakout storage where the prairie refineries are furnished their crude supply. These tanks are at Rosetown, Stony Beach, and Regina, in Saskatchewan; and at Brandon and Gretna, in Manitoba. From Gretna there is a pipe line running north, about 70 miles, to Winni-



A New Protective Coatings Series for *Elevated Working Temperatures*

The new Pitt Chem 600 Series of baked Epoxy Coatings provides you with an improved and specialized weapon for combating industrial corrosion. Effective for many applications involving elevated temperatures, Pitt Chem Epoxy Coatings offer these important advantages:

✓ *Excellent Flexibility*

✓ *Outstanding Alkali Resistance*

✓ *Toughness—High Mar Resistance*

✓ *Good General Chemical Resistance*

Send for Additional Information on PITT CHEM **EPOXY** *Today!*

★ Hot Applied Tar Base Coatings
★ Cold Applied Tar Base Coatings
★ Alkyd Coatings
★ Chlorinated Rubber Coatings
★ Vinyl Coatings
★ Phenolic Coatings
★ Epoxy Coatings

WAD 3925

Protective Coatings Division
PITTSBURGH COKE & CHEMICAL CO.
GRANT BUILDING - PITTSBURGH 19, PA.

COAL CHEMICALS • AGRICULTURAL CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON

peg, through which Imperial's new refinery is supplied, as well as another small local plant.

Pump Stations

From the map (Fig. 1) it will be noted that pump stations are situated at Kerrobert and Regina, in Saskatchewan; at Cromer and Gretna, in Manitoba; and at Clearbrook, in Minnesota. The construction of these stations was closely tied in with the tight building schedule of 150 days. It was particularly important that the more western states be completed on time, inasmuch as it had been the intention to try to deliver crude to Regina at the earliest possible date. This had the effect of reducing the price of products in that area. The oil to the lake head, on the other hand, could follow along, provided it arrived there in sufficient quantity to fill the storage tanks before navigation opened on the lakes.

The construction of the Canadian stations was not easy. They were built by a Canadian contractor who, although fully competent, had never before constructed a pumping station. Several of the stations were located at isolated points in the prairies where the maintenance of labor was extremely difficult. The station at Clearbrook, Minnesota, on the other hand, did not present quite the same problem because it was constructed by a firm for whom this work was almost an everyday occurrence. Also it was near a paved highway where the transportation did not cause the inconvenience suffered by the Canadian contractor.

All these construction problems were fully anticipated. There was nothing that could be done about the severe weather conditions with which everyone was faced, and there was the need to get the job finished in the fewest possible days. It was a trying time for everyone who had anything to do with the construction in those days. But it was finished, and the first oil arrived in Superior in early December, 1950. By the opening of navigation last spring, about 1,700,000 bbl of crude were in storage awaiting the arrival of the first tanker.

The line has been laid with 3½ ft of cover, which studies indicated would provide sufficient depth to avoid too much difficulty from the standpoint of frost penetration. During our first winter of operation the oil reached an average low point of about 30 F, which was approximately the figure anticipated. During August of this past summer the oil temperature had risen to a maximum of about 60 F.

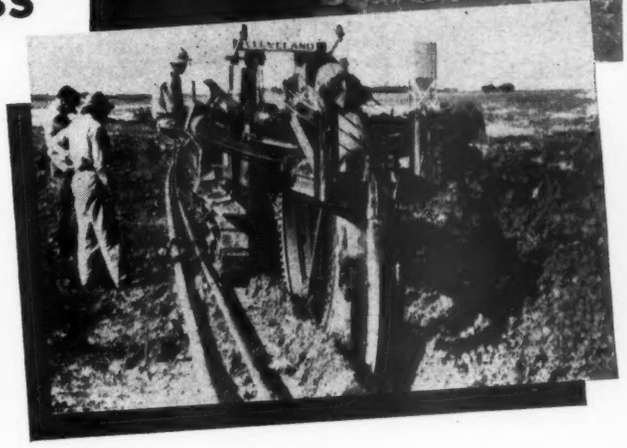
The effect of the extreme cold on line throughputs has been studied very extensively in Interprovincial's operations, but there still remains a great deal of work to be done. We have found that there is a difference in throughput of about 8 per cent—assuming average temperatures of 30 and 50 F. We also believe that the ordinary viscosimeter does not provide accurate readings below the wax point of the crudes we are pumping today. In an attempt to obtain some definite data on this subject, we have constructed, at the University of Alberta, a pilot pipe line. There is nothing particularly new in its design, but we believe it is the first of its kind built to simulate actual operating conditions in a cold climate. We hope to learn more about the pump-ability of the crudes now going through our line, as well as similar data on future crudes that might be discovered and that eventually may be tendered to us.

River Crossings

There is one major river crossing on the Interprovincial system. East of Rosetown, in Saskatchewan, the line crosses the South Saskatchewan River, which, in the spring, often becomes a wild torrent—with large quantities of ice tearing its way through the soft banks. In the summer months, usually in August, it becomes a quiet stream—with sand bars becoming exposed in all directions. It is a very unstable river because the sand bars constantly shift position. An attempt was made to lay the line in the river during the winter when the ice was thick. Unfortunately the job did not work out, and it became necessary to wait until summer. In Canada it has been proved that river

lease lines — field lines — water lines
gathering, transmission and distribution lines
...pipelines large and small

CLEVELANDS
ARE MONEY-MAKERS
ON *ALL* THE TRENCHING JOBS



Because CLEVELANDS give you the last word in fast modern efficient production on all your trenching work —long or short lines, tough or normal—with important savings on operating costs and machine investment. Check with your local distributor on the engineering features that fit each CLEVELAND for more different kinds of jobs, that keep CLEVELANDS out in front on yardage production and keep them out of the repair shop—features that add up to the high mobility and maneuverability necessary in oil-field work.

THE CLEVELAND TRENCHER CO.
20100 ST. CLAIR AVENUE CLEVELAND 17, OHIO

crossings generally can be successfully carried out by working through the ice, and it was only because of the peculiar local conditions that this particular crossing was a failure at that time. As a matter of fact, our crossing of the North Saskatchewan River was made during the winter.

Personnel

The maintenance of personnel at the pumping stations is nothing new to pipe line companies. To some it may be a real problem; and, with a varying degree of difficulty, certainly Interprovincial is in this group. The remoteness of some of our stations constituted the major hurdle. At the location across the prairies, where they are not adjacent to any community, we have built houses that have proved to be expensive; but there was no other way we could be sure of having our people available when they were needed. During the winter the transportation to and from the stations again had us beaten.

Capacity

With the 6 original stations on the line, the rated capacity is about 95,000 bbl per day out of Edmonton. It is designed for 1000-psi working pressure. Of this capacity, about 40,000 bbl per day are dropped off along the way at the various prairie refineries—with the remaining 55,000 bbl being delivered at Superior.

During this first full year of operation, viz., 1951, approximately 13,000,000 bbl of Canadian crude will be moved out of Superior by tanker between April and December. The local market at Superior for this crude is about 4000 bbl per day.

The pumping equipment at the stations consists of 6 and 8-cylinder diesel engines, which drive centrifugal pumps through speed increasers.

The Future

As to the future, we are told that the potential crude production in western Canada definitely warrants an increase in the amount of oil delivered to Ontario markets. Therefore, Interprovincial this year is constructing 5 additional pump stations — 4 in Canada and 1 in the United States—plus a further group of 12 storage tanks at Superior. These storage tanks will be about the largest ever built, viz., 217,000 bbl each; and these will bring the total storage at Superior up to 4,400,000 bbl. This program is expected to be completed with the stations operating and the tankage filled by April, 1952.

On this basis deliveries out of Superior will be increased about 5,000,000 bbl next year.

The picture beyond 1952 is not so clear as we should like to see it, inasmuch as it is so closely tied in with the plans of various shippers. Our throughputs to the lake head are dependent upon the quantities of crude that can be transported from Superior. This means capital expenditures by the shippers for tankers and storage at the eastern refineries, because they must not only transport the oil, but must provide for their winter runnings from the crude transported in the summer months.

It does appear, however, that we have a construction program next year. It will probably mean a further increase in the Superior storage to a total of 7,000,000 bbl, which is necessary to provide for a crude movement by tanker of 26,000,000 bbl. Our line capacity will have to be increased to accomplish this, and we expect to obtain this increase by looping 100 miles of the 16-in. section in Saskatchewan and Manitoba. We would then be pumping out of Edmonton at about 155,000 bbl per day, and we would have a daily line capacity into Superior of 112,000 bbl.

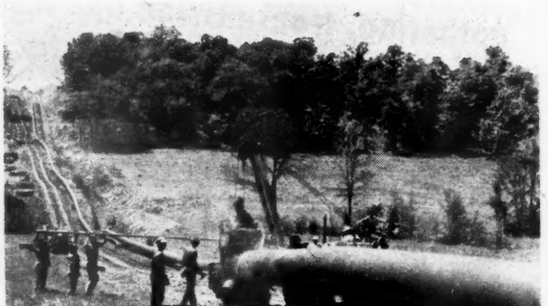
Beyond 1952 we are definitely not making plans. Possibly in the next 12 months we shall have the answer as to how and where we are going to get additional capacity. * * *

W. C. Jackson, an engineer of the Shell Oil Company Merval pump station near Los Banos, California, was awarded a medal for helping to rescue two truck drivers from a flaming trailer truck that had overturned.

a stronger felt for longer life

NICOLET*

ASBESTOS PIPE LINE FELT

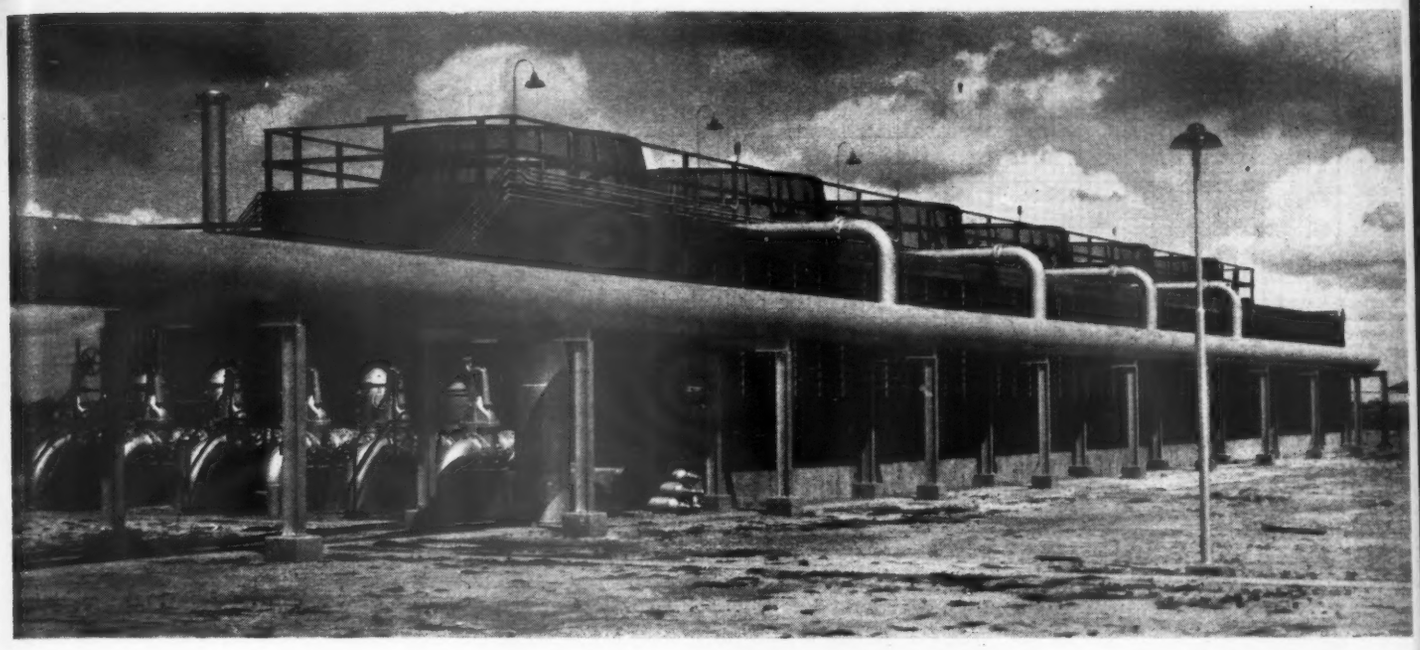


NICOLET Asbestos Pipe Line Felt is made of high quality asbestos fibers. These extra strong Canadian chrysotile fibers make NICOLET Felt a positive reinforcement for the enamel and an effective shield for all underground pipe against soil stress and all corrosive conditions.

MANUFACTURED BY:
NICOLET INDUSTRIES, INC.
(FORMERLY GAMA INDUSTRIES, INC.)
70 Pine Street
New York 5, N. Y.

DISTRIBUTED BY:
MIDDLE WEST COATING & SUPPLY
207-A Daniel Bldg. Tulsa, Okla. Ph. 2-5215
P. O. Box 153 or 2-5216

* Formerly GAMA



Cooling tower.

STEAM TURBO-COMPRESSOR STATIONS

Characteristics of the centrifugal blower and its adaptation to the pipe line problem

H. LEE NORRIS, JR.*

PART 2

THE application of a centrifugal compressor to the pipe line transmission problem was touched upon in Part I, and it was inferred that modifications necessary to conventional blowers to adapt them to pipe line application consisted of redesigning the casings to withstand pipe line pressures and providing an efficient shaft seal to prevent leakage along the shaft. These are precisely the steps that have been taken in adapting the centrifugal blower, which has been a work horse in industry for more than 50 years, to the gas pipe line pumping problem.

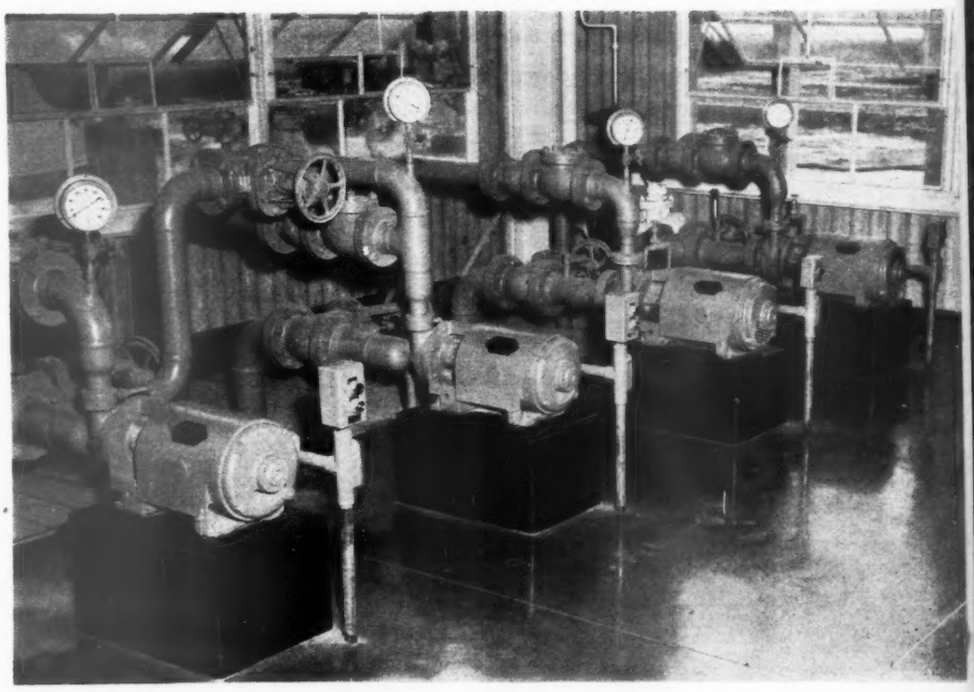
A brief review of the characteristics of a centrifugal blower will be made and then the discussion will be expanded to the pipe line problem.

The centrifugal blower belongs to the same family of rotating machines that includes centrifugal fans and centrifugal pumps. In the centrifugal pump the fluid handled must be liquid and in the

*Fish Engineering Corporation.

EXCLUSIVE

Utility and transfer pumps.



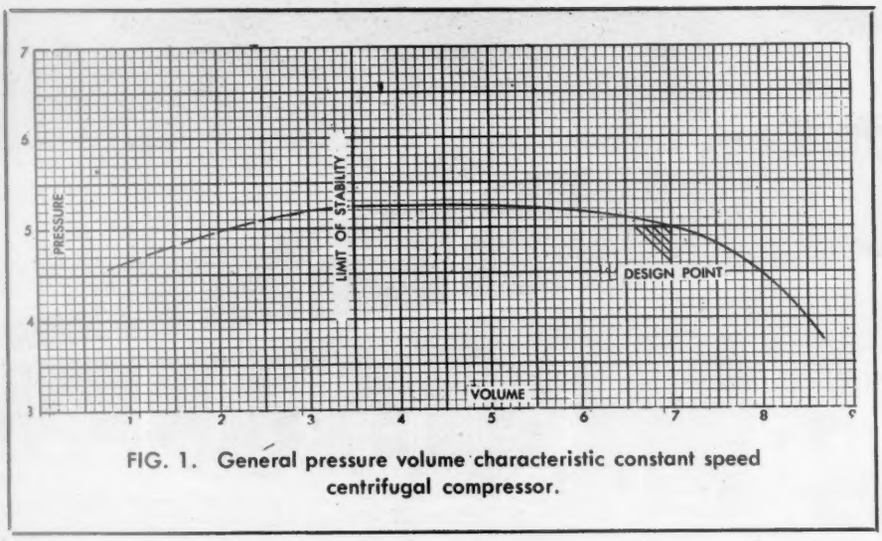
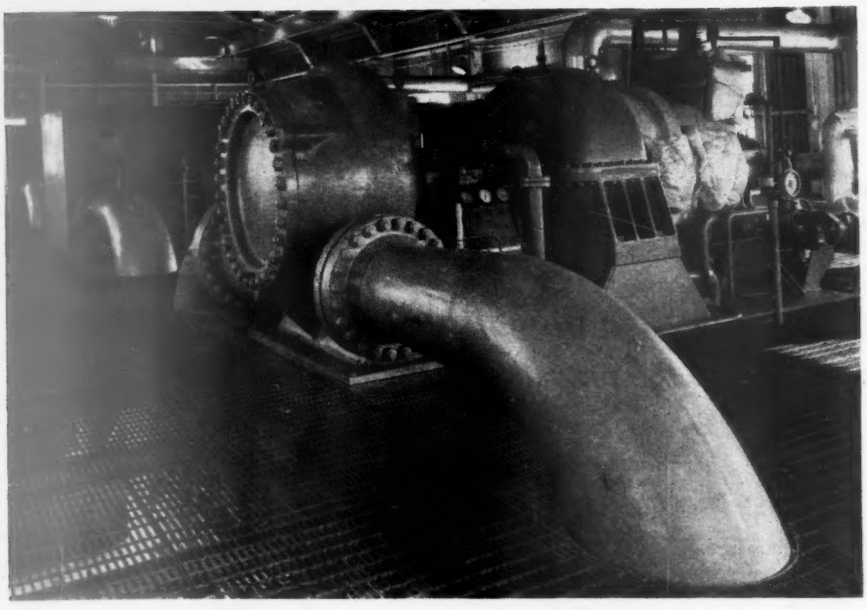
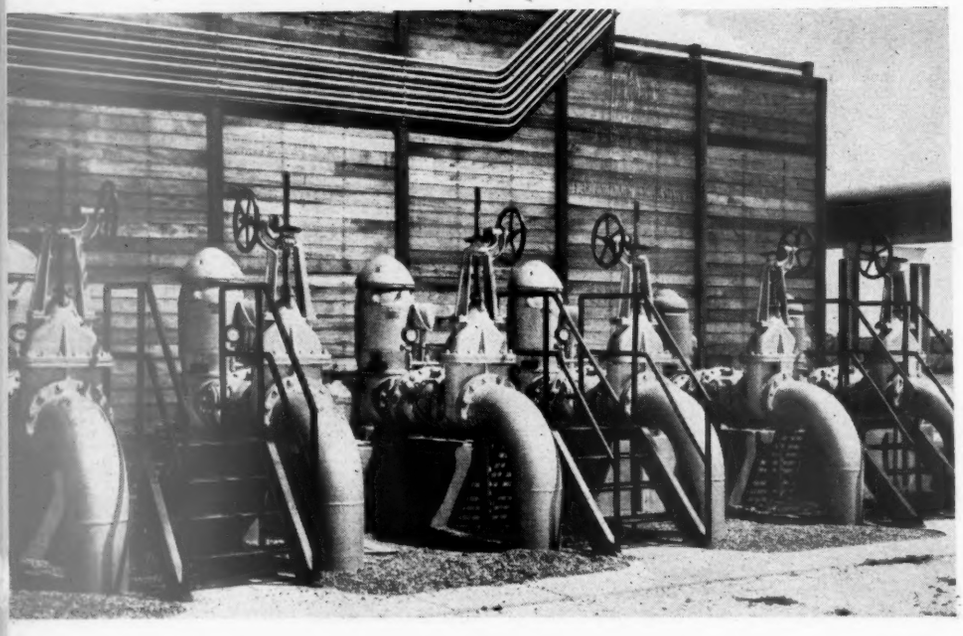


FIG. 1. General pressure volume characteristic constant speed centrifugal compressor.

Compressors and turbines at Tylertown, Mississippi, station of Transcontinental Gas Pipe Line Corporation.



Pumps for circulating water from the cooling tower through the condensers.



case of water and hydrocarbons, which are the fluids most generally handled, they may be considered incompressible. The centrifugal fan operates at such a low pressure rise that the air or gas that it handles may be considered as being incompressible without serious error.

The centrifugal blower, like the centrifugal fan, operates on air or gas, and unlike the centrifugal pump and centrifugal fan, the fluid is compressed appreciably in passing through the blower, which precludes the use of a centrifugal pump or centrifugal fan theory without making allowance for changes in volume due to pressure and temperature change.

One fundamental fact in the theory of all centrifugal machines is that the pressure rise is in feet of head of the fluid being pumped. Head in feet of fluid plotted against volume of fluid flow provides a most useful relationship and allows performance of centrifugal blowers or compressors to be predicted quite accurately, even when operating under conditions radically different as regards pressure, temperature, nature of gas, etc., from those conditions under which the compressor was tested or designed.

The above reasoning may be summed up in saying that the performance of a given centrifugal compressor, when measured in feet of head of the fluid being pumped, depends entirely upon volume and speed. Thus, if the compressor is handling air, its performance will be expressed in feet of air. If it is handling gas, its performance will be expressed in feet of gas. The use of the feet of head concept is complicated by the change in density that occurs as a particle of gas proceeds through the compressor and has both its pressure and temperature changed. Therefore, the concept of feet of head must be changed to feet of head of gas at a mean density or feet of head of the same gas being compressed through the same pressure change isentropically.

Fig. 1 represents the pressure volume characteristics of a typical centrifugal compressor operating at constant inlet conditions and constant speed. It will be noted that the curve extends back to approximately 50 per cent of design volume. The reason for extending the curve back to only approximately 50 per cent of design volume is because in that region the compressor's operation becomes unstable. This instability is due to the change in slope of the pressure volume curve in such a manner that a decreased volume causes a decrease in discharge pressure. As pressure is what causes the volume to flow, a decrease in pressure causes a decreased volume, which, in turn, causes a decreased pressure and so on, until the volume actually becomes zero and the inertia of the gas will cause, under some circumstances, a back-flow of the compressor.

The foregoing is a rough and ready description of how centrifugal compressors will become unstable at something less than 50 per cent of design volume. A more rigidly correct explanation of

Igloo or Jet Engine...

Wherever temperatures are important to you, there's a dependable American Thermometer or Temperature Measuring Instrument for the purpose. The line is so complete, selection for specific needs is easy, whether you require accurate temperature measuring instruments to safeguard product quality, protect equipment or control costs.

American Thermometers and Temperature Indicators and Recorders are available in ranges from minus 100°F. to plus 3000°F., with *actuation by mercury, vapor pressure, gas, bi-metal or thermocouple* —depending on instrument type and requirements. And, to indicate or record temperatures accurately as far as 250 feet from the temperature source, famous "Magic Pulse" self-compensating capillary tubing can be supplied.

Whether you must know the exact temperature of a kiln, processing vat, deep freeze – anything hot or cold – choose from the many fine American Thermometers and Temperature Measuring Instruments. New catalog gives complete details.

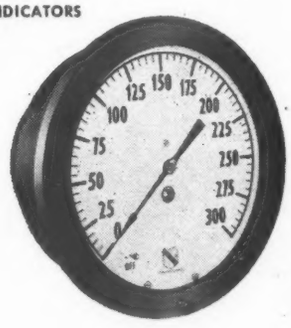
Stocked and Sold By Leading Distributors

AMERICAN RECORDING THERMOMETERS

Single, double, or triple pens in round or rectangular cases. 10-inch chart with effective scale width of 3⅝" for easy, accurate reading. Chart Drive: 24-hour spring wound or electric. Actuation: mercury, vapor pressure, or gas. Ranges from minus 60°F. to plus 1000°F.

AMERICAN ELECTRONIC TEMPERATURE INDICATORS

A radically new pyrometric-type instrument. Combines the unique Microsen Balance with the sensitivity of thermocouple measurement. Extremely accurate, rugged, dependable. Power actuated pointer. Ranges from minus 100°F. to plus 3000°F. American Electronic Temperature Recorder also available.

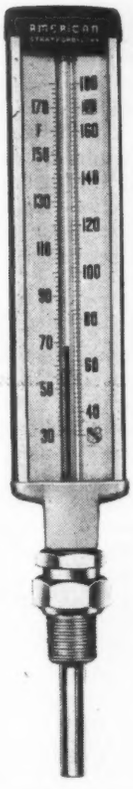


AMERICAN DIAL THERMOMETERS

Clear, bold figures on exactly graduated dials; pointer of contrasting color. Actuation: mercury, vapor pressure, gas, or bi-metal. Ranges from minus 60°F. to plus 1000°F. Cases for stem, wall, or flush mounting.

AMERICAN INDUSTRIAL GLASS THERMOMETERS

Full scale opening of 7", 9", or 12" with easy-to-read red mercury tubing. Ranges from minus 80°F. to plus 1150°F. Straight and angle forms.



1850 AMERICAN U.S.A.

AMERICAN INDUSTRIAL INSTRUMENTS

MAXWELL MANNING M&M & MOORE INC. TRADE MARK

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES. BUILDERS OF "SHAW-BOX" CRANES, 'BUDGIT' AND LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

this phenomena can be made with aerodynamic theory in which a surging centrifugal compressor is very closely akin to a stalled aerofoil. Flyers in an airplane experiencing a stall have noted the same sort of a flutter that takes place in a surging centrifugal compressor. Compressors should never be operated for extended periods while surging.

In pipe line practice, it is convenient to operate compressor stations at fixed discharge pressure in order to preserve line pack and to keep horsepower at the minimum. This means that the centrifugal blower or compressor in effect has become a centrifugal exhauster whose inlet pressure is a function of flow and whose discharge pressure is constant. These applications occur rather widely in the industry, for example, coke over gas exhausters and salt filter exhausters. The function that expresses the relationship between flow and inlet pressure in the case of pipe line practice turns out to be the widely used Panhandle Formula applied to a section of pipe line that receives gas at constant pressure from a compressor station and delivers gas at a variable pressure to the next compressor station inlet.

Another similarity between centrifugal pumps, centrifugal fans, and centrifugal compressors is that a rough and ready relationship exists between speed and volume, pressure and horsepower, which is useful for illustrative purposes. Many engineers are familiar with this relationship known as the "Fan Laws", which states that the volume varies directly as the speed, the pressure varies as the square of the speed, and the horsepower varies as the cube of the speed. This is a restatement of the generalization concerning the flow of fluid in a given conduit, where the volume varies directly as the speed; pressure drop varies as the square of the speed; and power, being the product of pressure times volume, varies as the cube of the speed. This generalization, although only approximate, is valid for all types of centrifugal machines because the flow of fluids is involved. These fan laws may be applied provided suitable corrections be made for viscosity, friction factors, efficiency, etc.

In order to illustrate the application of single-stage centrifugal compressors, operating in series, driven by a variable speed driver, Fig. 2 is included. This is the general performance of single-stage centrifugal pipe line compressors in series with variable speed drivers. The point of beginning on this family of curves is the station inlet pressure, which in this case is the calculated pres-

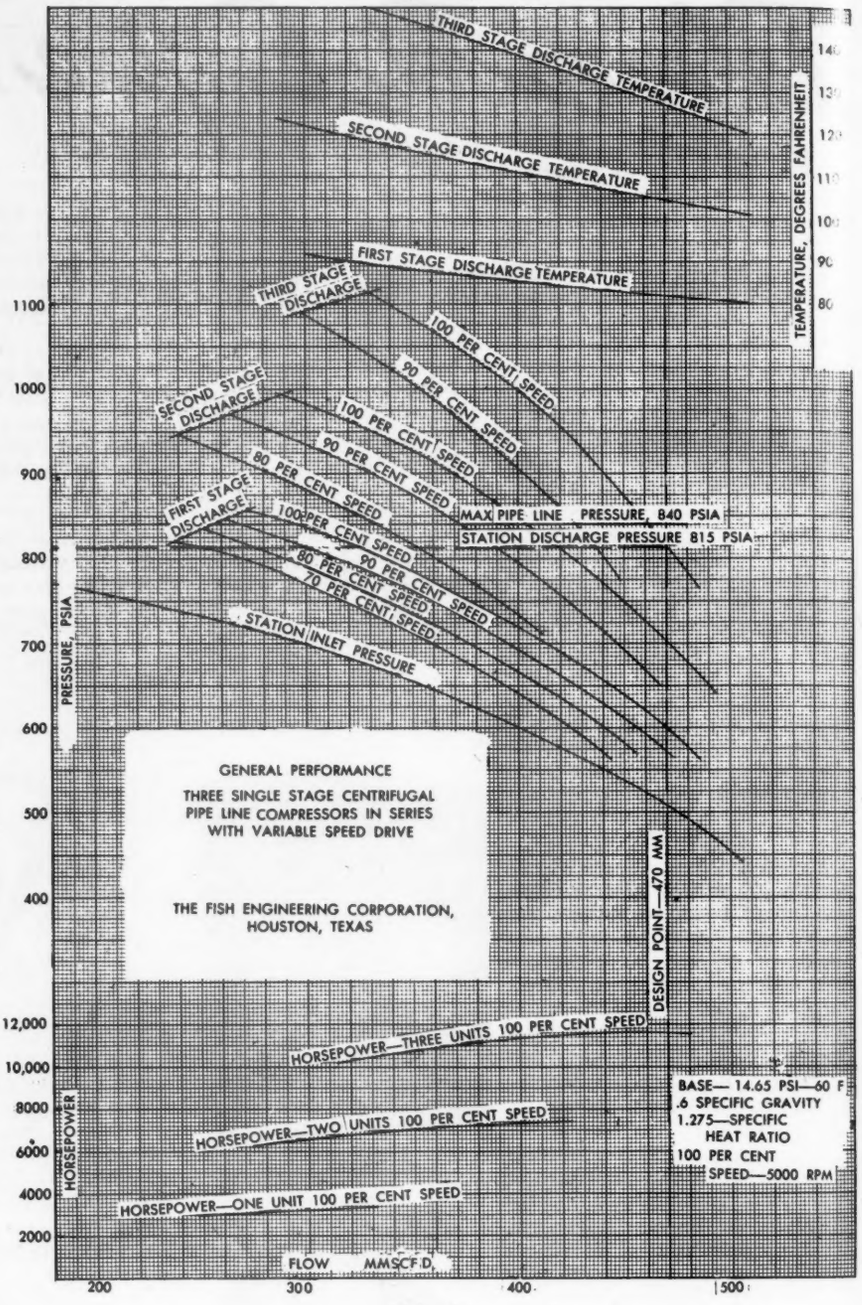


FIG. 2.

Boiler building at Tylertown, Mississippi, background, and water treating plant, foreground.

Jaeger's "new standards" give more air to do 30% to 40% more work

Model 600 Jaeger Compressor (600 cfm at 100 psi) operates these two 4" wagon drills at full pressure drilling 30% to 40% more footage per hour than with any 500 cfm compressor. Jaeger's 15% to 25% higher "new standards" provide the air you need to hold full pressure behind tools that otherwise would loaf under weak 70 lbs. pressure—or operate additional tools where speed and striking power are not required. See Catalog JC-1.

THE JAEGER MACHINE CO., 662 Dublin Ave., Columbus 16, Ohio

Sales and Service in 130 Cities

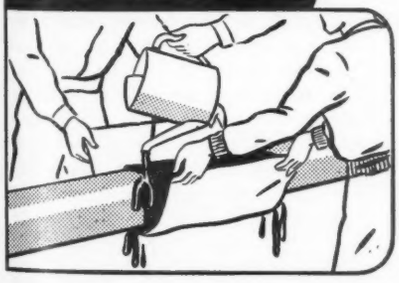
COMPRESSORS, 75 to 600 cfm • PUMPS, 3600 to 240,000 gph • CONCRETE MIXERS

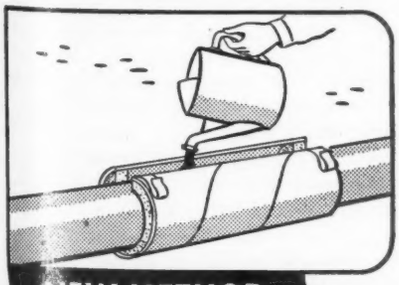
FIELD JOINTER

PAT. APPLIED FOR

Slip on-Pour full-Lower in

OLD METHOD





NEW METHOD

"Field-Jointer" construction features heavy, rigid, paper mould equipped with felt inserts for each end, preventing waste, plus heavy adhesive tape fasteners. One-quarter inch spacing between pipe and mould gives positive assurance of protection. Slip on—Pour full—Lower in.

The "Field-Jointer" represents a new technique of coating field joints and skid-marks with the same material used on pipe at the coating machine. Slip-on "Field-Jointer" over joint, pour enamel, fasten, and you are ready to lower-in. The canvas sling method is slower, and does not provide assurance of adequate protection for pipe bottoms. Use of "Field-Jointer" provides following features for field use.

- ★ **Eliminates waste of material**
- ★ **Eliminates clean-up operations**
- ★ **Operates simply requiring no skilled labor**
- ★ **Affords positive proof of pipe-bottom protection**
- ★ **Prices and additional information, plus arrangements for field demonstrations furnished on request.**

Contact us direct or:

Line Products Corp., Foot of Magnolia Ave., Elizabeth N. J.
S. D. Day Co., 1973 W. Gray, Houston, Texas
Mel Maddox, P. O. Box 165, Little Rock, Arkansas
J. H. Longaker, 1204 Russ Bldg., San Francisco, Calif.

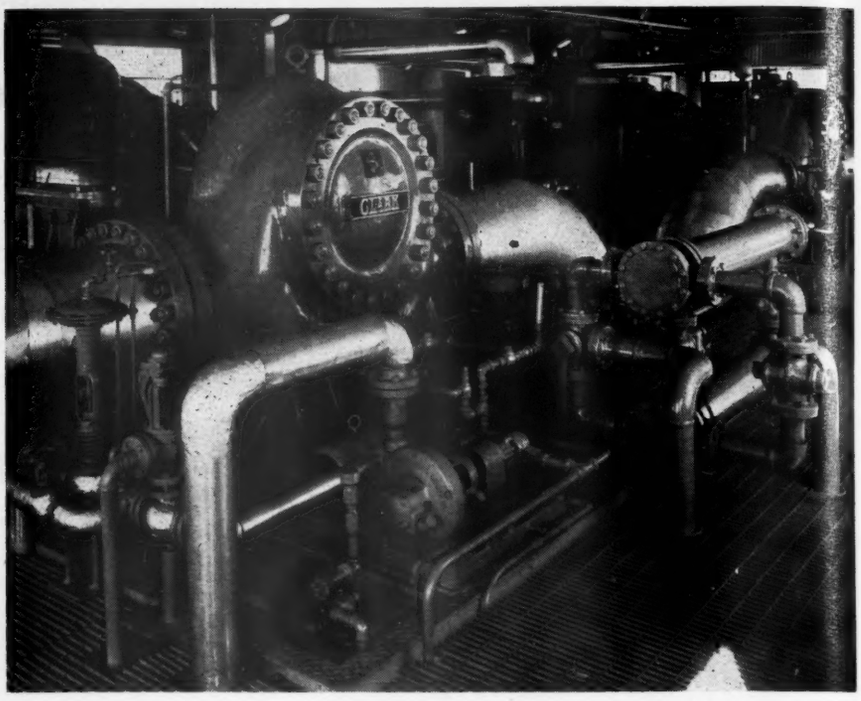
AMERICAN COATING SUPPLY COMPANY

3-8704—Phones—4-4333
Box 3085—Whittier Station—Tulsa, Okla.

sure at the end of a 60-mile section of 26-in. OD by 9/32-in. wall pipe, flowing 0.6 gravity gas at 60 F. The inlet pressure of this 60-mile section of line is 815 psia and the ratio of specific heats of the gas is taken to be 1.275. The curve, as plotted in Fig. 2, has included pipe line efficiency based on the Panhandle Formula of 95 per cent. The design flow is 470,000,000 std. cu ft per day, using 14.65 psia at 60 F, base. The station inlet pressure read from the curve is 506 psia and the discharge pressure is 815 psia for a ratio of 1.6107. The shaft horsepower is 11,600, the discharge temperature is 125 F based on 60 F inlet temperature. The three compressors will operate at 5000 rpm, at design flow and pressure.

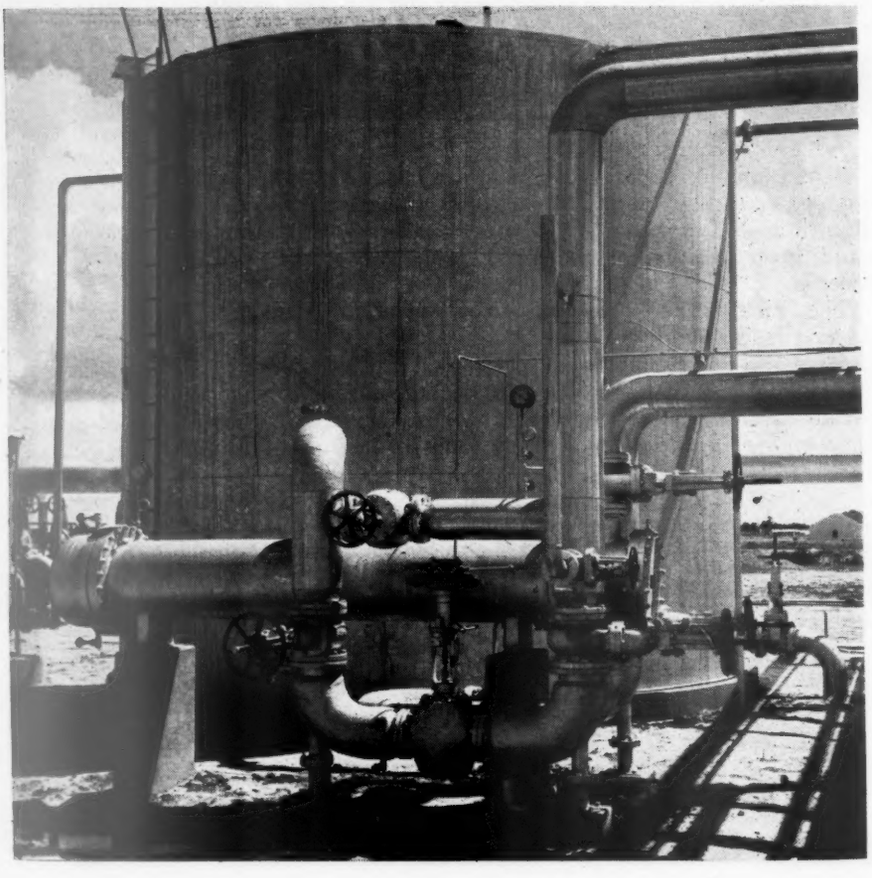
This general performance curve shown in Fig. 2 is representative of equipment available to the industry from either of several manufacturers. It may be used, within rather narrow limits, for estimating purposes for flows different from 470,000,000 std. cu ft per day, by a simple ratio of flows. The results obtained will be valid for estimating purposes only and before final selection is made the various compressor manufacturers should submit their proposal curves, which will be found to be in the same general form as the curves shown in Fig. 2.

The general form of performance curves for centrifugal compressors is the same, but the design point of an individual compressor determines its dimensions such as impeller diameter and speed, impeller width, area of casing passages, etc. Compressors can be designed to operate efficiently at flows approximating 300,000,000 std. cu ft per day up through 1,000,000,000 std. cu ft per day at usual pipe line pressures. The centrifugal compressor is inherently a large-volume low-ratio machine. For low volumes and high ratios its efficiency falls off to the point where it should not be considered for pipe line application. Looking at the 100 per cent speed, third-stage discharge pressure curve, with flow at 320,000,000 std. cu ft per day, Fig. 2 shows a discharge pressure of 1150 psia. This pressure could never be permitted on the usual pipe line and should the line conditions be such as to require 320,000,000 std. cu ft per day, the station discharge pressure of 815 psia could be met with only one compressor running at 100 per cent speed, giving 817 psia—as closely as the curve can be read. It will be noted from examination of these curves that the effect of operating these compressors as exhausters is that it gives them unusually steep characteristic curves; and, the characteristic curves become steeper as the number of the stage increases and the spread between full speed and partial speed performance becomes wider as the number of stages increase. It is not, however, to be inferred that should the flow in the pipeline suddenly drop from 470,000,000 to 320,000,000 std. cu ft per day that the discharge pressure would rise to 1150 psia and surely burst the pipe line. This is prevented first by the action of a pressure regulator, which will regulate the compressor speeds either individually or in unison, automatically slowing the compressors down to maintain the required 815 psia discharge pressure. Should the automatic pressure controller be inoperative, this over-pressure condition could develop only very slowly due to the immense storage in pipe line sections preceding and following the compressor station



Interior of Transcontinental's station at Billingsley, Alabama, showing compressors and turbines.

Excess steam condenser. Treated water tank in background.



under consideration. Assuming the station to be operating at its design point, the discharge pressure would rise only approximately 10 per cent because the station inlet pressure would have to rise from 506 psia to 682 psia before the third-stage discharge pressure could rise to 1150 psia. The quantity of packed gas in the pipe line sections preceeding and following a centrifugal compressor station is so great that pressure change can be made only as rapidly as line flowing conditions can equalize, which allows ample time to control discharge pressure by slowing down all compressors or by taking one or two compressors out of service. For this reason no safety valves are required to relieve excess pressure.

The upper family of curves in Fig. 2 shows discharge temperatures of the gas for all three stages. It is readily deduced from the curves that a temperature in excess of approximately 140 F cannot be exceeded under any circumstance of operation so long as gas is actually flowing. This temperature is low enough that it will not damage customary pipe coating material and, hence, it is not necessary to install aftercoolers in order to protect pipe line coatings. It may be desirable to install aftercoolers for their effect in increasing pipe line capacity. At the present time, not too much information is available to the designer on the heat dissipating characteristics of gas transmission lines, but it can be said qualitatively that their heat dissipating capacity is enormous.

The industry consistently uses a slightly different method in calculating horsepower for centrifugal compressors than is used for reciprocating compressors, the difference being in that the calculations of horsepower for centrifugal compressors includes effects of Gas-Law Deviation. The fundamental expression for isentropic horsepower in a centrifugal compressor is as follows:

$IHP = P_oQ_oXK$

Where:

P_o = inlet pressure, psia

Q_o = inlet volume, CFS at flowing conditions

$X = \left(r^{\frac{n-1}{n}} - 1 \right)$

r = compression ratio

$n = \frac{\text{specific heat at constant pressure}}{\text{specific heat at constant volume}}$

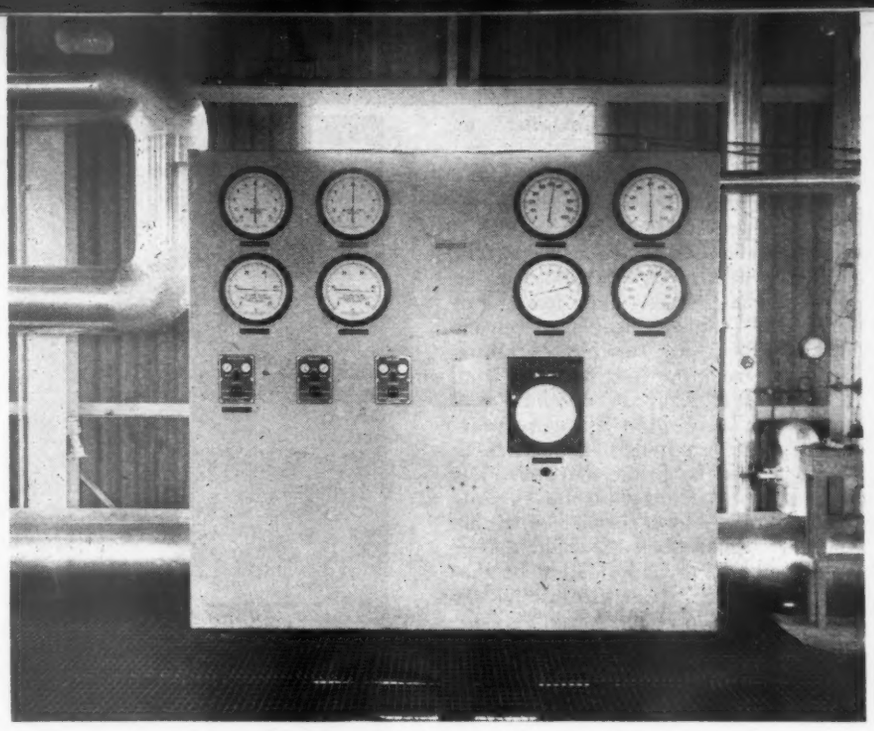
$K = 0.1317 \times$ specific heat at constant pressure $\times$ Moi. Wt.

In the above formula for isentropic horsepower the inlet pressure is the pressure at the compressor inlet flange and the inlet volume is the actual volume flowing in cubic feet per second at conditions at the compressor inlet flange, which includes the appropriate deviation factor. It is interesting to note that when a centrifugal compressor, of the high efficiency as is now currently available, compresses natural gas, the temperature and pressure changes are such that the deviation factor remains approximately constant. No serious error is introduced by assuming the deviation factor to remain constant. Shaft horsepower is obtained by dividing isentropic horsepower by compressor efficiency. Efficiencies of modern compressors will be above 80 per cent.

Should it be necessary to operate the pipeline, designed for 470,000,000 std. cu ft per day, at a flow of less than 250,000,000 cu ft, which is one compressor operating at 70 per cent speed, the station discharge pressure would have to be lowered below 815 psia in order to keep the volume at the compressor inlet flange large enough to avoid surging. Lowering the discharge pressure of all compressor stations on the line will permit its operation at a perhaps 100,000,000 std. cu ft per day. The economics of transmission pipe lines will not allow this low a flow of 21.3 per cent of design capacity and, hence, this situation is not likely to exist for very long.

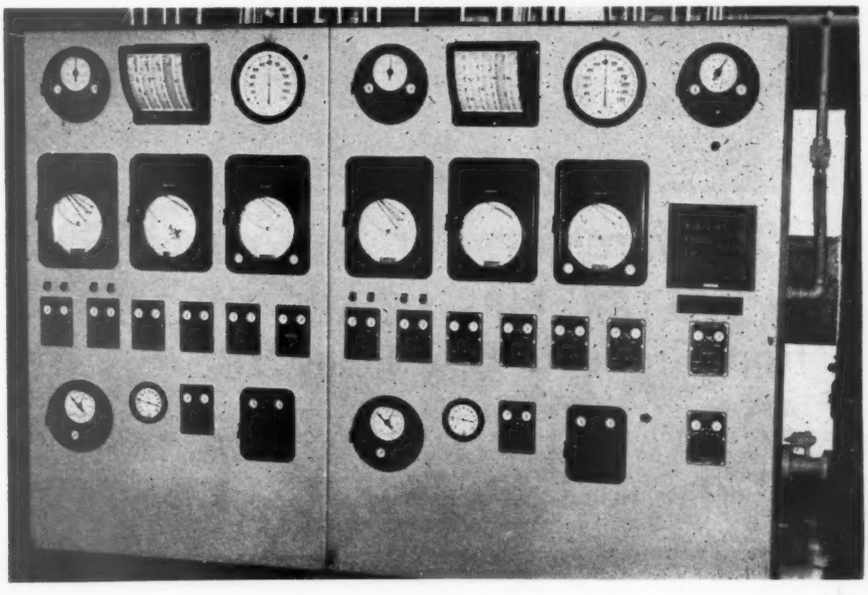
Referring again to Fig 2, it will be noted that the characteristic curves of all three stages are cut off by the horizontal line at 815 psia, which is design station discharge pressure. Twenty-five pounds above this is another horizontal line at 840 psia, which is the maximum pipe line pressure. This spread between maximum pipe line pressure and station discharge pressure coupled with overload capability of the compressor station will determine maximum pipe line flow with one compressor shut down. If this spread is sufficient and there is sufficient overload capability in compressor stations all along the line, the complete loss of one compressor station need not seriously cripple the capability of the pipe line. This factor should be examined for an entire pipe line rather than one individual station.

The driver for a centrifugal compressor may be an electric motor, a diesel or



Control panel in main compressor room.

Control board in auxiliary building.



Control center.

gas engine through gears, a steam turbine, or a gas turbine. The choice of driver depends almost entirely upon the economics of a given situation. Gas engines, diesel-engines, and steam turbines are highly developed prime movers which are capable of taking their fuel from the line itself or from an external fuel supply and have had their reliability proved by many years operations in hundreds of industries. A new-comer to the prime mover field is the gas turbine. The gas turbine exhibits great promise, and experience with this type of apparatus is accumulating rapidly due to the application of this type of machine to jet aircraft, power generation, and pipe line work.

It is questionable whether the steam-turbine or gas-turbine can ever compete on a thermal efficiency basis with reciprocating gas engine compressors or gas or diesel engines driving centrifugal compressors through gears.

In a later article the selection of a driver for centrifugal gas compressors for pipe line transmission systems will be discussed. * * *

☆ ☆ ☆

The first oil pipe line connecting the Atlantic and Pacific Oceans will soon begin operating across Mexico's Isthmus of Tehuantepec.

EXCEL-SO
COMBINATION
SEPARATOR—FILTER
Equipped with Model Q Coalescing Baffle

. . . for removal of bulk quantities
of WATER, PIPE SCALE & ROUGE
from Products Pipe Lines . . .

The Six HPQ-1000-AC Excel-So Combination Separator-Filters shown above are under construction for Plantation Pipe Line Company's Baton Rouge Pumping Station. Today more and more Products Pipe Line Companies are using EXCEL-SO Units to remove water and dirt from products streams either as primary coalescers or as first-stage units in connection with desiccant dehydration.

Write for Bulletin FEQ-51

WARNER LEWIS COMPANY
BOX 3096 • TULSA, OKLAHOMA

NEWS

Proposed Rate Increases Exceed $100,000,000

The total amount of proposed rate increases pending before the Federal Power Commission has passed the $100,000,000 mark for the first time, with the filing of an application by Transcontinental Gas Pipe Line Corporation, of Houston, Texas, for an increase of approximately $13,600,000.

Transcontinental's proposed increase, which is estimated on the basis of 555,000,000 cu ft per day delivery capacity for the year 1952, brings the total of pending rate increases to more than $106,000,000 annually.

With the exception of Transcontinental's proposal, which is under study by the staff, all proposed increases have been suspended by the FPC pending a determination of their reasonableness. The increases involve 18 interstate pipe line companies, including Transcontinental. Transcontinental is proposing to make its increase effective in December. The company said the increase is necessary because of higher operating and construction costs, increased federal taxes, and the new Texas state gathering tax on natural gas.

Diesels Make Enviable Record

Advantages of moving oil to market through a pipe line depend to a considerable extent on whether the cost of pumping power can be kept within reason. This is especially true where pipe lines connect far flung areas. For instance, one company operates 1400 miles of trunk and gathering lines to serve a great part of Texas.

One section is handled by diesel engine driven pumps taking oil at 10 psi and raising it to 900 psi for discharge into the line. The diesels are 6-cylinder, 327-rpm, 400-hp, Atlas units connected to the pumps through gear drive. Although being consistently overloaded during the war years, and operating on a 12,000-hr overhaul schedule, the engines have run up an enviable record of performance.

After 70,000 hr of operation more than 80 per cent of the original main bearings and 60 per cent of the original connecting-rod bearings were still in use, and average cylinder wear was about 0.022 in.

Records of one station show that during a 25-month period, one engine was available for service 100 per cent of the time, whereas the other, down for servicing 40 minutes, had an availability of 99.99 per cent.

In one year the two engines pumped almost 10,000,000 bbl of oil. During this period, they consumed 192,832 gal of fuel oil and 833 gal of lubricating oil. At 6 cents a gal for fuel oil and 70 cents per gal for lube oil, the cost of fuel and lube oil was only 1.2 mills per bbl of crude pumped into the pipe line.

Service Pipe Line Nears Completion

Residents of Raytown, Independence, and Sugar Creek have a front row seat to observe how the oil industry is working to meet the increasingly heavy civilian and military demands for more petroleum products.

A 16-in. crude oil pipe line being constructed by the Service Pipe Line Company is now squeezing its way through the streets of these three Missouri towns. The new pipe line will be capable of delivering to the Standard Oil Company (Indiana) refinery in Sugar Creek about 68,000 bbl a day, according to H. G. Mariner, Carrollton, division manager for the company in Missouri.

Service Pipe Line Company has operated a pipe line from its Freeman, Missouri, pump station to the Sugar Creek refinery since 1923. The present line composed of 8-in., 10-in., and 16-in. sections is inadequate to meet the refinery's increased demand for crude oil.

Although the pipe lines pass near the homes of hundreds of persons, its constant day and night operation has been so quiet that many of them have forgotten its existence.

Construction of the new line began October 8 at the company's Outerbelt junction along the Outerbelt road in southern Jackson County. The line is being built by the Sheehan Pipe Line Construction Company, Tulsa, Oklahoma, and has been approved by the Petroleum Administration for Defense. It is scheduled for completion by December 15, Mariner said.

For 21,500 ft north of U. S. Highway 40, through the cities of Independence and Sugar Creek, the big line will be solidly encased in concrete. This protection for the line has two purposes—to prevent other construction operations from damaging it, and to prevent corrosion causing possible leaks. The concrete jacket will protect the line also through Raytown, and in Raytown Heights, Loveland addition, and Hollis Acres. All crossings under railroads and highways will be encased in steel. There will be 4165 ft of steel casing installed for 55 different crossings.

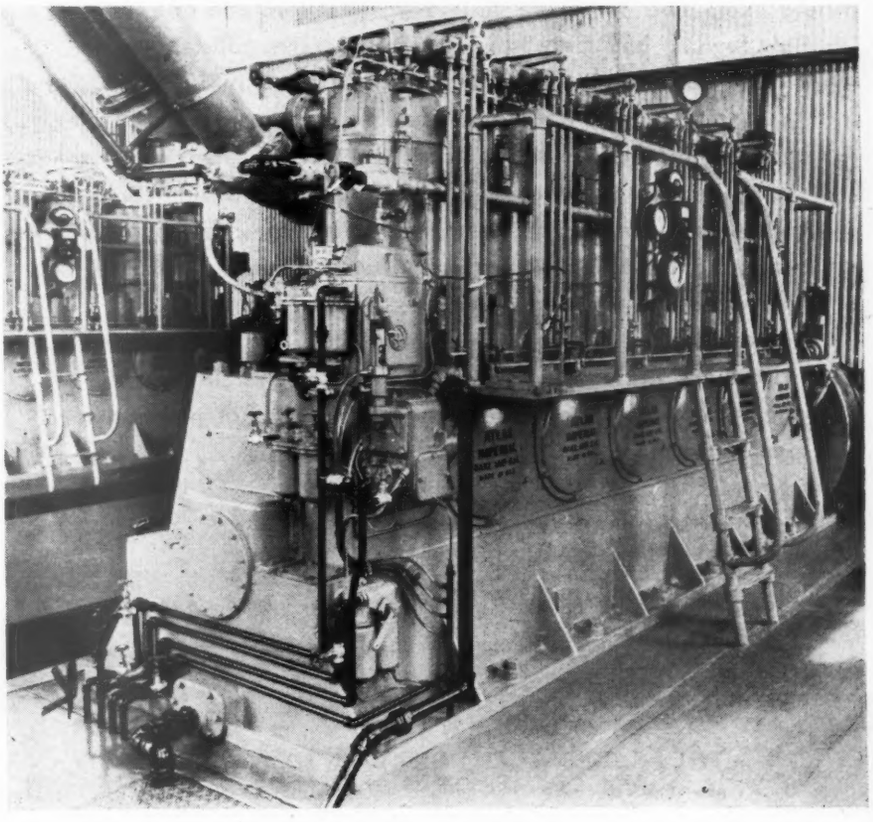
The entire line will be given a coating of Somastic, and will be cathodically protected to prevent corrosion. The Somastic coating is being applied by H. C. Price Company, Bartlesville, Oklahoma.

Most of the right-of-way is on publicly owned properties as the line generally follows Hardy and Northern avenues north to the refinery from U. S. Highway 40.

Harvey Jones, former city engineer for Independence and a member of the Tri-County Planning Commission, assisted the company in locating the line and obtaining the necessary clearance through the municipalities.

The company maintains a construction office at 412 North Sterling avenue in Sugar Creek. George Koons, Service Pipe Line Company connection foreman, is chief inspector for the company, and is assisted by seven company inspectors and a field clerk.

After 11 years in oil line pumping service, these two 400-hp, 6-cylinder, 327-rpm, Atlas diesels still give new engine performance. In the 25 months since last overhaul, their service availability has been 99.99 and 100 per cent.



use pipe line crude as diesel fuel ?

YES

with the* SHARPLES *crude oil purifying system

You can save thousands of dollars on diesel fuel costs every year by using pipe line crude oil in your diesels instead of expensive light fuels . . . and there is no sacrifice in engine efficiency.

Pipe line crude is effectively and continuously purified to ASTM specs for ash content for diesel fuel by the Sharples Oil Purifier, under action of the greatest centrifugal force commercially available. The non-cratering fuel that results will assure complete engine combustion on diesel engines of all types. Continuous and automatic, the easy-to-clean centrifuge requires a minimum of maintenance or attendance to keep it working on an every-day, 24 hour-a-day shift.

Designed especially for Pumping Stations, this Sharples system also features a special fuel handling system that prevents any recontamination of purified oils.

it will pay you to investigate.

SHARPLES

THE SHARPLES CORPORATION • 2300 WESTMORELAND STREET, PHILADELPHIA 40, PENNA.

NEW YORK • BOSTON • PITTSBURGH • CLEVELAND • DETROIT • CHICAGO • NEW ORLEANS • SEATTLE • LOS ANGELES • SAN FRANCISCO • HOUSTON

Gas Revenues and Income Reported to Federal Power Commission

Operating revenues of natural gas companies reporting to the Federal Power Commission totaled $97,348,337 in August, 1951, an increase of 17.2 per cent over August, 1950, receipts of $83,026,494. For the 12 months ended August 31, 1951, revenues aggregated $1,480,929,896 or 23.2 per cent higher than the $1,202,088,469 received in the 12 months ended August 31, 1950.

Gas utility operating income for August, 1951, amounted to $9,185,437, up 3 per cent from the $8,916,496 reported for August of last year. For the 12 months ending with August, 1951, gas utility operating income was $227,942,410, representing an increase of 11.2 per cent over the $204,917,705 reported for the comparable period ending in August 1950.

Net gas utility plant of the reporting companies aggregated $3,529,065,333 on August 31, 1951, up $595,294,425, or 20.3 per cent over the $2,933,770,908 reported a year ago.

Symonds Principal Speaker at Convention Of Pipe Line Contractors' Association

Gardiner Symonds, president, Tennessee Gas Transmission Company, Houston, Texas, will be the principal speaker at the Fourth Annual Convention of the Pipe Line Contractors Association to be held at The Shamrock Hotel, Houston, Texas, January 8 and 9, 1952. Symonds is well-known as a leader in the pipe line industry, and his company, which has recently completed a large expansion program, is an honorary member of the Pipe Line Contractors Association.

Forty-three pipe line contracting firms, who have built practically all of the cross-country pipe line systems during the past several years, comprise the active membership of the association. In addition, there are 64 associate members consisting of firms engaged in subcontracting, manufacturing of equipment, equipment dealers, and suppliers.

The Pipe Line Contractors Association was organized in the fall of 1947 and active membership is limited to those who have been engaged in general pipe line construction and who have a reputation for skill, integrity, and responsibility. It is affiliated with The Associated General Contractors of America, a trade association consisting of more than 5500 general contractors.

In line with a policy adopted by the board of directors of the association no exhibits of equipment will be made at the convention this year.

Program chairman for the annual convention is James P. Neill, Western Pipe Line Constructors, Inc., Austin, Texas. Present officers of the association are as follows: President, L. H. Favrot, Houston Contracting Company, Houston, Texas; vice president, Robert Thomas, Texas-Louisiana Contractors, Fort Worth, Texas; vice president, Robert A. Conyes, Conyes Construction Corporation, San Pablo, California; treasurer, E. J. Mahoney, Jr., Mahoney Contracting Company, Lansing, Michigan; executive secretary, Richard A. Gump, Dallas, Texas.

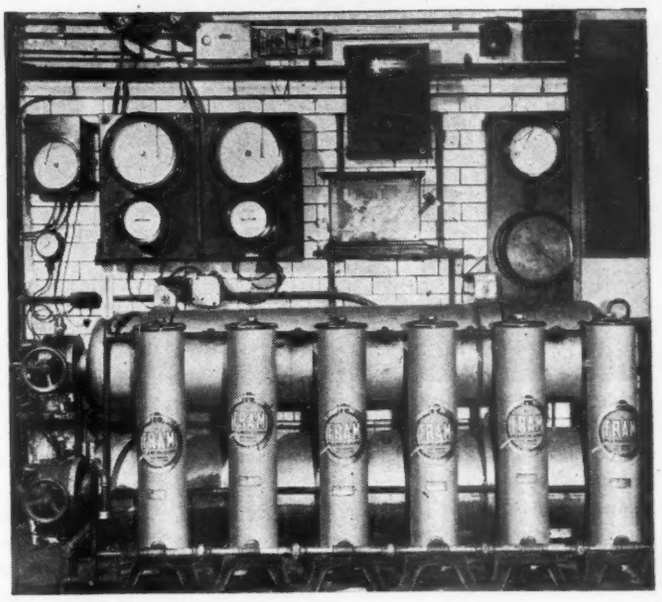
Texas Eastern Awards Construction Contracts

Texas Eastern Transmission Corporation has announced the award of the final three pipe line job contracts and the remaining river crossing contracts in the construction of Texas Eastern's 791 miles of 30-in. pipe line from Kosciusko, Mississippi, to Connellsville, Pennsylvania.

Anderson Brothers Corporation, of Houston, Texas, has been awarded the contracts for Jobs 8, 9, and 10 extending from the Ohio River near Portsmouth, Ohio, to a point near Connellsville, Pennsylvania, a total of 217 miles. Job number 8 extends from the north side of the Ohio River near Portsmouth, Ohio, 77 miles north and east to a point near Amesville, Ohio. Job number 9 extends from a point near Amesville, 74 miles to the Ohio-West Virginia crossing of the Ohio River. Job number 10 extends from the second crossing of the Ohio River to a point near Connellsville, Pennsylvania, a distance of 66 miles.

Texas Eastern has awarded to Williams Brothers Company of Tulsa, Oklahoma, contracts for river crossings under the Hocking River, the Muskingum River, the Monongahela River, and the Ohio-West Virginia crossing of the Ohio River.

Pentzien, Inc., Omaha, Nebraska, has been awarded contract for a pipe line crossing under the Ohio River near Portsmouth.



These six Fram Filters serve 840 h. p. Fried Krupp Diesel at large eastern university. This Diesel drives a 600 kw. Crocher-Wheeler generator.

University Cuts Maintenance Costs of Diesel Power Plant with FRAM Filters

Four Fram Filter installations filter dirt, grime, sludge and carbon from lubricating oil of 545 h.p., 630 h.p., 840 h.p. Fried Krupps and a 448 h.p. Baldwin in power house of large eastern university. Engineers consider Fram Filters the best . . . definitely a money-saver. Absolutely no maintenance except changing cartridges.

FRAM Filcron Filters Do the Job Better!

- *Remove solid and abrasive contaminants 1 micron (.000039") and larger*
- *Minimize Engine Wear*
- *Reduce Engine "Down-time"*
- *Extend Engine Life*
- *Lower Operating Costs*

No matter what your Diesel oil filtering problem—either fuel or lube—Fram can help you conquer it. Write for full information today to FRAM CORPORATION, Providence 16, R. I. *In Canada:* J. C. Adams Co., Ltd., Toronto, Ontario.

FRAM *Filcron*

THE MODERN OIL FILTER

Price Officials Gather for Anniversary Party. Top officials of the H. C. Price Company gathered in Bartlesville, Oklahoma, recently to help celebrate the company's thirtieth anniversary. It was the first time in the organization's history that all superintendents had met together. Front row, left to right, are M. J. Lane, Somastic Division superintendent; C. E. Shivel, C. R. Ice, R. K. Shivel, and G. A. Reutzel, Pipeline Division superintendents; and Nelson VerSoy, Somastic Division superintendent. Second row, R. P. White, Somastic Division manager; J. S. Dewar, Somastic Division vice president; Harold C. Price, president; John M. Thomas, Pipeline Division manager, and J. B. Harshman, Pipeline Division vice president.

Jackson Heads Standard's Products Pipe Line Department

Sam L. Jackson has been appointed manager of the products pipe line department of Standard Oil Company (Indiana), Frank O. Prior, executive vice president, announces. Jackson succeeds D. L. Rankin, who has become manager of Wyco Pipe Line Company at Denver, Colorado.

W. A. Bennett succeeds Jackson as assistant manager of Standard's products pipe line department. Bennett is vice president and former general superintendent of Wyco.

Wyco Pipe Line Company, a common carrier, has a petroleum products pipe line from Caspar, Wyoming, refineries to terminals at Cheyenne, Wyoming, and Denver. It is owned by Standard Oil Company (Indiana), The Texas Company, and Socony-Vacuum.

Jackson joined Standard Oil Company (Indiana) in March, 1951, as assistant manager of the products pipe line department after serving with Service Pipe Line Company since 1928.

He joined the pipe line company as an engineer's helper and advanced to division civil engineer in 1935. He became senior engineer in 1946 and a year later assistant chief engineer, at Tulsa, Oklahoma, which position he held when he joined Standard.

A native of Durant, Oklahoma, he attended Southeastern State Teachers and the University of Oklahoma.

Bennett joined Standard Oil (Indiana) in 1936 as a member of the sales engineering school at its Whiting, Indiana, refinery. He subsequently served in the South Bend, Indiana, sales field as an agent instructor, reseller salesman, lubricating salesman, and industrial salesman.

In 1946 he became a lubrication engineer in the Duluth, Minnesota, sales field and later that year was transferred to the products pipe line department in the general office at Chicago. He was superintendent of the eastern and northwestern lines for Standard when he became general superintendent of Wyco at Denver in 1947.

Bennett was born in Duluth and attended schools in Houghton, Michigan. He was graduated from Michigan College of Mining and Technology.

PIPELINE
PRICE
CONSTRUCTORS

America's Foremost Pipeline Constructors

H. C. PRICE CO.

PHILADELPHIA ● BARTLESVILLE ● NEW ORLEANS

Pursuant to an order by the Owner, We Will Sell at . . .

Public Auction

WEDNESDAY, DECEMBER 12

Starting at 10:00 A.M. (Rain or Shine)

PIPELINE CONSTRUCTION EQUIPMENT

Consisting of

TRACTORS	TRUCKS - TRAILERS	DOPE POTS
WELDING MACHINES	PUMPS	CLEANING MACHINES
BACK HOES	DITCHING MACHINES	PIPE LINE TOOLS
	COMPRESSORS	

Located at

3601 N. Sylvania Street, Fort Worth, Texas

Inspection from December 4 to Date of Sale

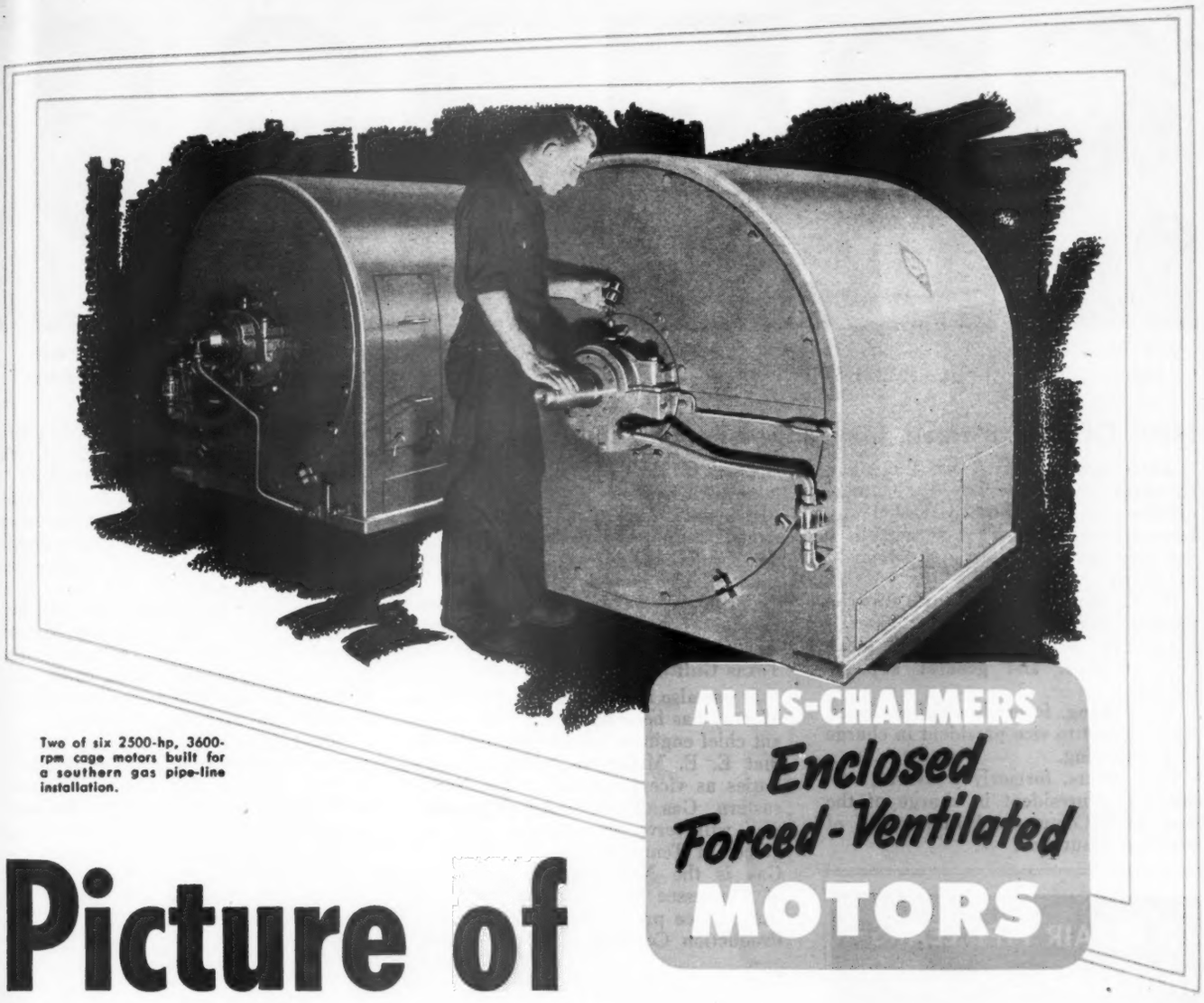
Ask for E. A. Bell

Send for illustrated folder to:

HETZ AUCTION SALES

P. O. Box 4187 • Phone VAlley 6541

FORT WORTH, TEXAS



Two of six 2500-hp, 3600-rpm cage motors built for a southern gas pipe-line installation.

ALLIS-CHALMERS
Enclosed Forced-Ventilated
MOTORS

Picture of Economy

FOR PIPE-LINE STATIONS

Start with a few of these Allis-Chalmers enclosed forced-ventilated motors. To complete the picture, add a common ventilating system. *That's* **what many engineers are prescribing for low-cost pipe-line stations requiring several large pump or blower motors.**

There are good reasons for this. These motors cost very little more than open machines. But they lead a charmed life because they run . . . and run . . . and run . . . in an atmosphere of cool clean air. That makes them easy to live with because they need very little attention . . . and the heat they produce is discharged outside the motor room.

What's more, adequate protection for these hazardous locations is provided by supplying the ventilating air under positive pressure — during starting and during operation.

For best results, the motors must, of course, be designed to meet specific pipe-line requirements . . . *and Allis-Chalmers motors are!* For example, the motors shown above are made for connection to air ducts in the foundation, but other motors can be built for connections at the top or sides to fit your installation plans.

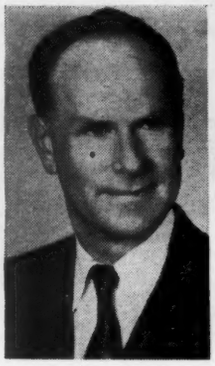
Details are important too. These motors have capsule-type bearings supported by split end shields. This permits easy access to the motor interior without exposing the bearings to dust and grit. Use of two oil rings per bearing assures uniform, uninterrupted lubrication. The supplementary forced-feed lubrication system used for these 3600-rpm motors is self-contained . . . and it's air-cooled . . . needs no cooling water supply.

Why not call in your nearby A-C representative. He can help you decide where to use these newly designed pipe-line motors. Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3535

ALLIS-CHALMERS

W. C. McGee, Jr.
Vice President

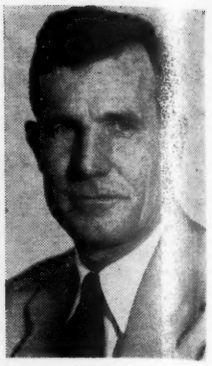


Joe J. King
Vice President

Carl Myers
Vice President

Cecil C. Johnson
Treasurer

Edward S. Murray
Chief Engineer



Earl McNeill
Vice President

New Officers Elected for Tennessee Gas Transmission

Three new vice presidents and a new treasurer were elected by the board of directors of the Tennessee Gas Transmission Company at a recent meeting, it was announced by Gardiner Symonds, president.

W. C. McGee, Jr., general superintendent of the company's 2000-mile natural gas pipe line system, was made vice president and general superintendent.

Joe J. King, formerly chief engineer, was elevated to vice president in charge of engineering.

Carl Myers, formerly treasurer, was made vice president in charge of the company's Commerce Building and of company insurance.

Cecil C. Johnson, formerly assistant controller, was elected treasurer.

Symonds said that the four were named to their new positions in view of the broader scope of their responsibilities and the increasing importance of their duties as a result of a major expansion of the company's pipe line system. The system now extends from the Texas Gulf Coast to New England.

It was also announced that Edward S. Murray has been promoted from assistant chief engineer to chief engineer and that E. E. Miller, in addition to his duties as vice president of the Northeastern Gas Transmission Company, also will serve as assistant chief engineer of Tennessee Gas. Northeastern Gas is the New England subsidiary of Tennessee Gas. Earl McNeill was elected vice president of the Tennessee Production Company, another subsidiary engaged in oil and gas exploration, and production in the Southwest. He formerly was general superintendent.

McGee and King have a broad background in the operating and engineering phases of natural gas pipe line systems. McGee is a graduate in civil engineering from Texas A and M and King is a graduate in mechanical engineering from the University of Texas. McGee joined Tennessee Gas as chief dispatcher in 1944 while King came with the company in 1946 as assistant superintendent of compressor stations.

Myers joined Tennessee Gas an controller in 1944 and became treasurer in 1947. Johnson went with the company as budget director in 1947 and has been assistant controller since the beginning of 1949. Both have a broad experience in public utility accounting.

Murray has been with Tennessee Gas since 1943, Miller since 1944, and McNeill since 1947.

TO REPAIR PIPE LEAKS—
QUICKLY, PERMANENTLY

ANY PRESSURE — ANY TEMPERATURE

SKINNER-SEAL EMERGENCY PIPE CLAMP
for pinhole or corrosion leaks.

SKINNER-SEAL PIPE LINE CLAMP for
long splits and bad corrosion leaks.

In stock—all supply stores

M. B. SKINNER COMPANY
SOUTH BEND 21, INDIANA, U. S. A.

Hearing for Gas Application

The Federal Power Commission has ordered a consolidated hearing to begin December 12 in Washington, D. C., on applications by Southern Union Gas Company, to increase natural gas deliveries in the Clovis, New Mexico, area, and El Paso Natural Gas Company to reduce deliveries of gas to Southern Union's supplier.

Southern Union, of Dallas, Texas, is seeking FPC authorization to construct a 300-hp compressor station and 10 miles of pipe line on its system, which serves Clovis, Portales, and Tucumcari, New Mexico. Estimated cost of the construction is $202,240.

El Paso, in its application, has asked the commission for authority to reduce deliveries to West Texas. The service agreement between the two companies provides that El Paso continue to sell up to 34,122,000 cu ft of gas a day to West Texas through June 30, 1952, with a reduction to 20,000,000 cu ft after that date and through June 30, 1956. El Paso said that West Texas has stated that not more than 20,000,000 cu ft will be required from it for peak day delivery for the 1952-53 and subsequent heating seasons, and the the proposed curtailment was requested by West Texas.

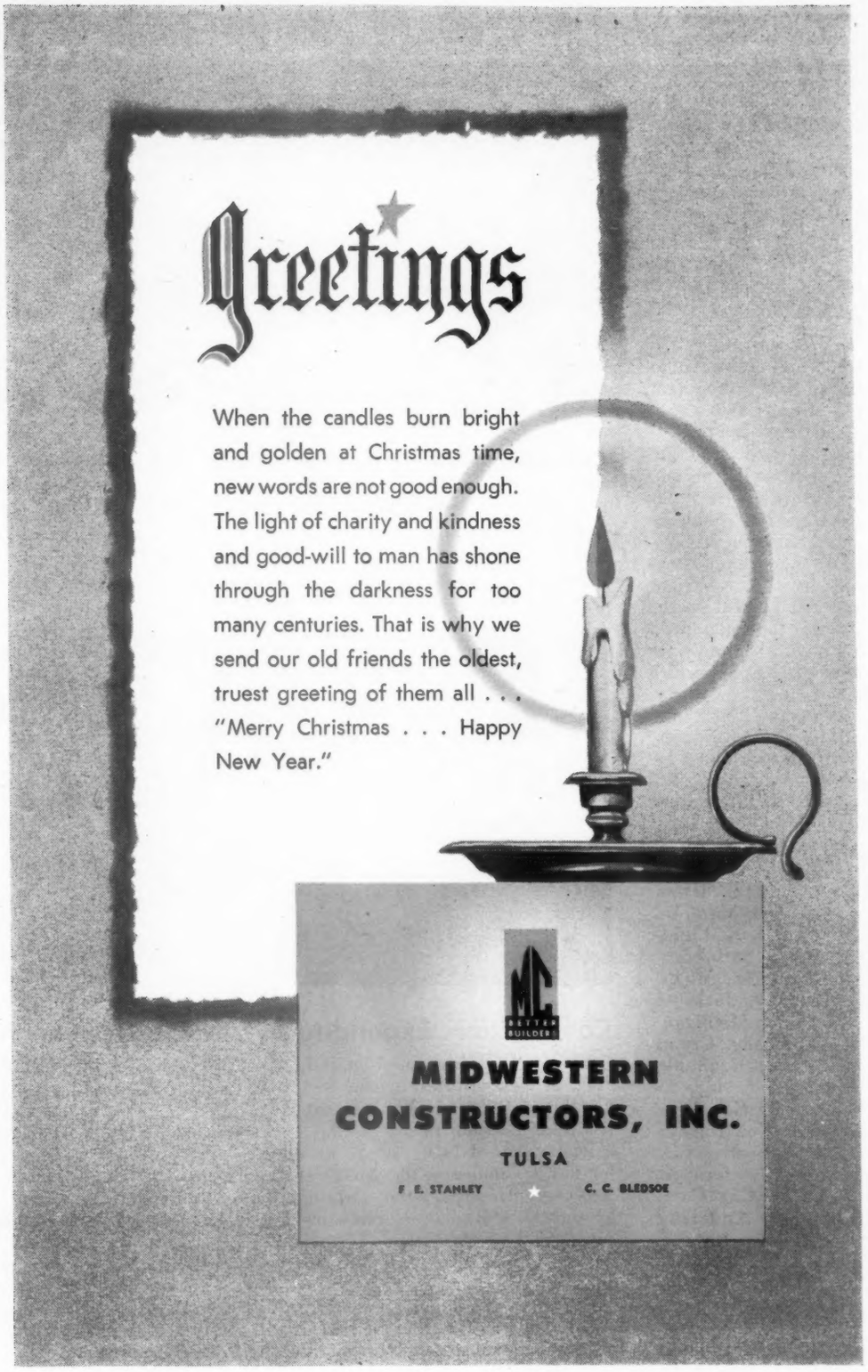
Construction Authorized

The Federal Power Commission has authorized Kansas-Nebraska Natural Gas Company, Inc., of Phillipsburg, Kansas, to construct additional pipe line facilities in Nebraska and Colorado that will increase the company's system capacity by 18,400,000 cu ft of natural gas a day to a total of 182,600,000 cu ft.

The construction program includes a 15-mile, 6⅝-in. line and 11 miles of 8⅝-in. from the Big Springs field in Deuel County, Nebraska, to Ogallala, Nebraska; 2 miles of 2⅜-in. lateral lines and two town border stations to serve Big Springs and Brule; 8 miles of 8⅝-in. and 5 miles of 4½-in. from the Big Springs field to Ovid; 13.5 miles of 2⅜-in. laterals and 10.5 miles of 3½-in. laterals and four town border stations to serve Chappell, Lodge Pole, Ovid and Julesburg; a 52-mile, 8⅝-in. line to replace the existing 4½-in. Ogallala-North Platte, Nebraska, line.

To Construct Short Line

The Federal Power Commission has authorized Central Kentucky Natural Gas Company, of Charleston, West Virginia, to construct about 13 miles of line, to carry additional natural gas to customers in the Cincinnati, Ohio, area.


Greetings
When the candles burn bright and golden at Christmas time, new words are not good enough. The light of charity and kindness and good-will to man has shone through the darkness for too many centuries. That is why we send our old friends the oldest, truest greeting of them all . . . "Merry Christmas . . . Happy New Year."
MC
BETTER BUILDERS
MIDWESTERN CONSTRUCTORS, INC.
TULSA
F. E. STANLEY
C. C. BLEDSOE

AGA Appoints Committee On Underground Storage

Underground storage of gas has become an important phase of the gas industry. In some areas it is helping to solve the twin problems of peak loads and gas house heating demand. With the rapid growth of the nation's natural gas pipe line systems gas storage has become of interest to all branches of the gas industry.

As a result of this growing interest, a Committee On Underground Storage has been appointed for the American Gas Association by Chas. E. Bennett, president, The Manufacturers Light and Heat Company, Pittsburgh, Pennsylvania, and chairman of the Natural Gas Department of AGA.

The duties of the new committee will be: (1) To assemble and publish statistical data relating to the development of underground gas storage and to encourage the publication of papers relating to the operation and scientific aspects of storage; (2) to encourage research and other forms of investigation relating to the solution of problems that arise from time to time in this important new phase of the gas industry.

Fenton H. Finn, New York State Natural Gas Corporation, Pittsburgh, will serve as chairman of the Committee On Underground Storage. Members will include: Frank Boyd, The Manufacturers Light and Heat Company, Pittsburgh; William F. Burke, Lone Star Gas Company, Dallas; M. V. Burlingame, Natural Gas Pipeline Company of America, Chicago, and Richard W. Camp, Consolidated Gas Utilities Corporation, Oklahoma City.

Also included are: Nelson P. Chesnutt, Southern Union Gas Company, Dallas; John B. Corrin, Jr., Hope Natural Gas Company, Clarksburg, W. Virginia; Marion L. Fort, Pacific Lighting Gas Supply Company, San Francisco; H. L. Fruechtenicht, Jr., Michigan Gas Storage Company, Jackson, Michigan; Harry J. Gabel, Michigan-Wisconsin Pipe Line Company, Grand Rapids; John V. Goodman, Equitable Gas Company, Pittsburgh; George C. Grow, Jr., Transcontinental Gas Pipe Line Corporation, Newark, New Jersey; Russel W. Hofsess, Cities Service Gas Company, Oklahoma City; Frederic A. Hough, Southern Counties Gas Company of California, Los Angeles; Charles C. Ingram, Oklahoma Natural Gas Company, Tulsa; Lysle R. Kirk, The Ohio Fuel Gas Company, Columbus, Ohio; Grove Lawrence, Southern California Gas Company, Los Angeles; Edwin L. Rawlins, Union Producing Company, Shreveport; J. J. Schmidt, The East Ohio Gas Company, Cleveland; D. T. Secor, United Natural Gas Company, Oil City, Pennsylvania; Charles W. Studt, Union Gas System, Inc., Independence, Kansas; E. C. Stump, United Fuel Gas Company, Charleston, W. Virginia. Eugene D. Milener, American Gas Association, will serve as secretary of the committee.

Presenting papers before the Division of Transportation, American Petroleum Institute, Chicago, are T. S. Johnston, left, Interprovincial Pipe Line Company; V. J. Sittel, Service Pipe Line Company; J. H. Peper, chairman, and F. H. Warren, Ohio Oil Company.

Members of the Committee on Pipe line Technology and subcommittees, who participated in Chicago program of API: J. W. deGroot, Tuscarora Oil Company; L. F. Scherer, Texas Pipe Line Company; R. G. Strong, Natural Gas Pipeline Company of America; J. R. Mills, Jr., Service Pipe Line Company; J. C. Stirling, Service Pipe Line; H. H. Anderson, Shell Pipe Line Corporation; D. H. Lewis, Shell Pipe Line; R. C. Nicholson, Shell Pipe Line; L. S. Wrightsman, Humble Pipe Line Company, and Morgan Martin, Gulf Oil Corporation.

Construction Expenditures Ahead Despite Shortages

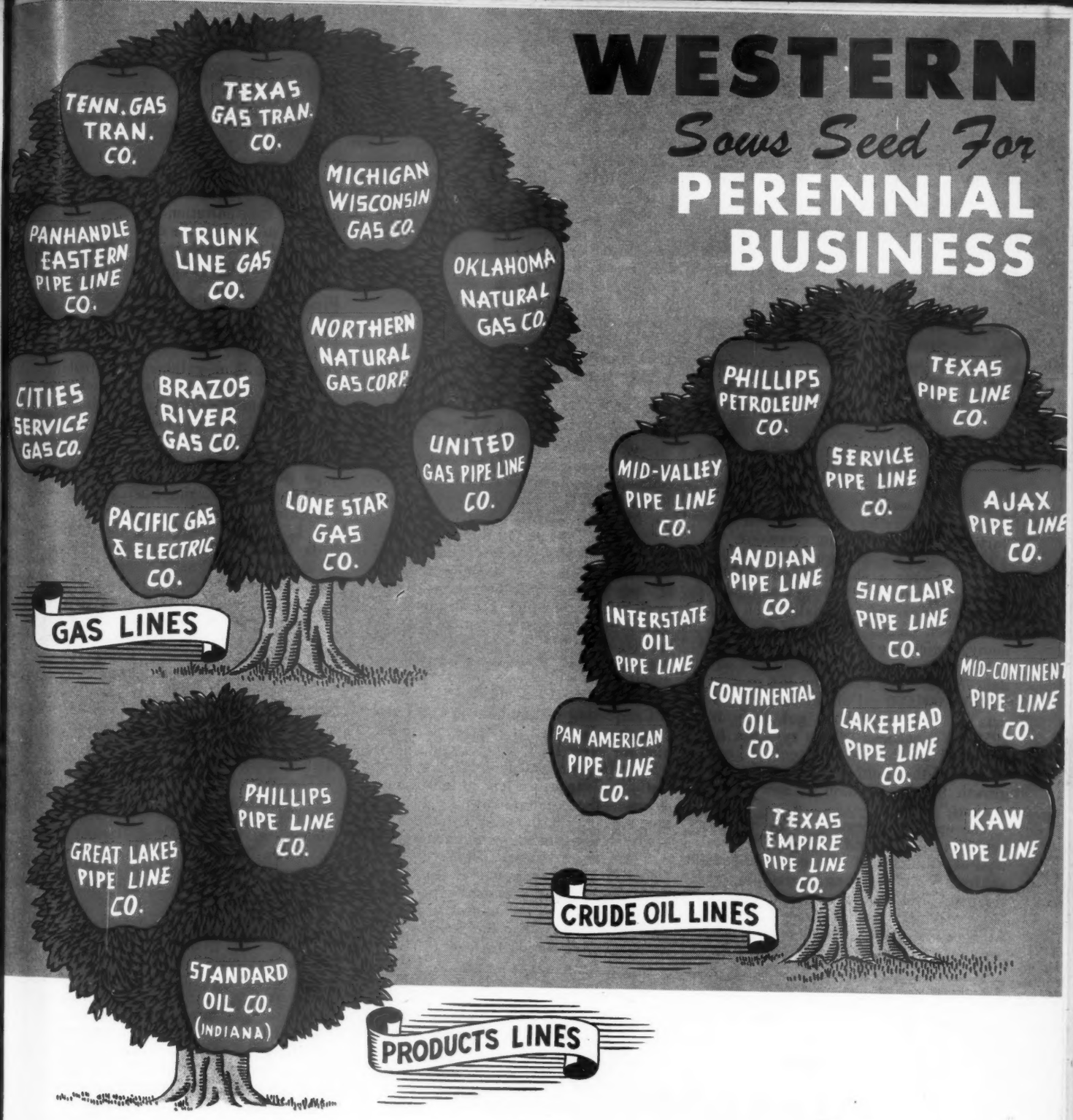
The total volume of new capital financing by gas utilities in the first nine months of 1951 already has exceeded the total amount raised in the entire calendar year of 1950, the previous peak for the gas industry, the American Gas Association reports. A recent tabulation by the AGA Bureau of Statistics indicates that construction expenditures during the current year are running ahead of last year's despite shortages of steel pipe and other vital materials. Capital raised from internal sources will not change substantially from that in 1950.

New capital financing during the first nine months of 1951 by straight gas utilities and pipe line companies aggregated $799,000,000, with $751,000,000 of this amount being raised by natural gas companies. This represents a gain of $43,000,000 or 5.7 per cent for straight gas companies in nine months over the $756,000,000 raised by these companies in the full year 1950. New capital raised by straight natural gas companies in nine months this year was $42,000,000, or 5.9 per cent ahead of the $709,000,000 raised by natural gas companies in the calendar year 1950.

These totals exclude the financing activities of combination companies that distribute electricity as well as gas, since there is no way to determine amounts required for the respective operations of these companies. During the first nine months of 1951 the combination utilities raised $551,000,000. It is probable that the total financing of these companies in 1951 will reach the $811,000,000 raised in 1950.

In addition to the financing consummated by straight gas utilities and combination companies, an additional $201,000,000 has been obtained by gas holding companies in the first nine months of this year, compared with $260,000,000 for the full year of 1950.

WESTERN
Sows Seed For
PERENNIAL BUSINESS



During these past five years of feverish development in gas transmission facilities we've participated very largely, both in the meeting of construction schedules on compressor station completions . . . and in the development of new cooling methods to meet demands peculiar to geographical locations.

At the same time that we were supplying this modern giant we have continued in the crude and products pipe line fields — examples — Mid-Valley and Great Lakes pipe lines. We plan to continue doing what we can to aid the petroleum industry in all phases of heat transfer equipment.

WESTERN
HEAT EXCHANGERS

Manufactured by
WESTERN SUPPLY COMPANY
P. O. BOX 1888 TULSA, OKLAHOMA

Plantation Pipe Line Doubles Capacity

Plantation Pipe Line Company, which transports petroleum products for delivery in six southeastern states, on December 4 will dedicate its new $52,000,000 parallel pipe line linking Baton Rouge, Louisiana, and Charlotte, North Carolina, with Governor Herman Talmadge as principal speaker.

The new 700-mile line, part of an expansion program Plantation began last year, will more than double its carrying capacity. It parallels the line which the company built 10 years ago to assure a continuous flow of liquid fuels from Louisiana and Texas Gulf-area refineries to southeastern markets.

In announcing plans for the dedication at Bremen, Georgia, Charles R. Younts, Plantation's president, said the new line is geared to the industrial and economic expansion of the South and to national defense needs. To highlight the line's importance national and state officials, educators and business men will participate in the opening ceremony.

Governor Talmadge's address will be broadcast over a closed circuit public address system to all of the company's pump stations and terminals. Each will hold "open house" the day of the ceremony, the company president said.

"With the opening of the new line our delivery rate will rise from the present run of 4,000,000 gal of petroleum products daily to 10,000,000 gal early in 1952," Younts said. "This rate can be increased another 50 per cent to keep pace with the South's future industrial growth by the addition of new pump stations."

The opening ceremony at Bremen, a key pump station and terminal 65 miles west of Atlanta, will also mark the 10th anniversary of company operations, the company president announced. Plantation's original system consisted of 1261 miles of main and lateral lines connecting the refining areas with 18 delivery terminals in these states: Mississippi, Alabama, Georgia, South Carolina, North Carolina, and Tennessee.

The new line is made up of 432 miles of pipe 18 in. in diam and 275 miles of 14-in. pipe, running parallel to the original combination of 12-in. and 10-in. line, which has its northern terminal at Greensboro, North Carolina. Both mains will serve the 8-in. and 4-in. branch lines, which carry products to such markets as Birmingham and Montgomery, Alabama, Columbus and Macon, Georgia, and Chattanooga and Knoxville, Tennessee.

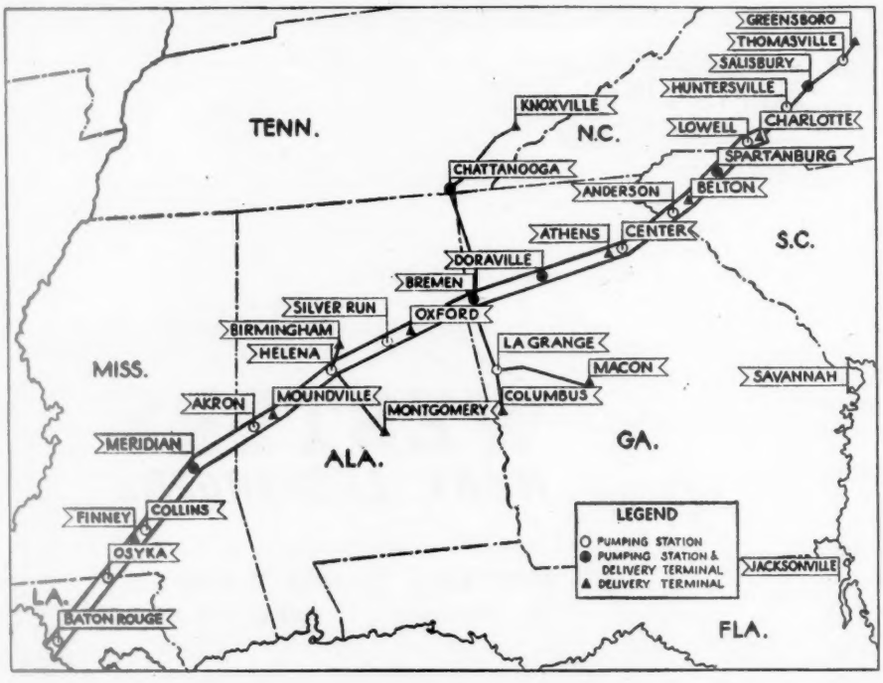
The Plantation system, which operates as a common carrier under ICC regulations, transports gasoline, kerosine, tractor and diesel fuels, and heating oils. These products are shipped through the line by 14 oil marketing companies, which take off at delivery terminals the identical products they put in at the starting point.

"Products are moved through Plantation's pipe line in batches of 25,000 bbl or more and pumped along at the rate of over 96 miles per day, seven days a week," Younts said. "The sequence in which products are placed in the line and high pumping pressures assures the marketer that product standards are maintained while en route. Constant laboratory checks verify this."

Completion of new tankage and new pumping facilities at Bremen is scheduled for early 1952, Younts said. Meanwhile, the company is enlarging pump stations along its system to that pumps to move the products will be situated about every 60 miles. Plantation's 18 pump stations on the completed system will constitute one of the biggest consumers of electric power in the southeast, the company president reported.

"The story of Plantation's 10-year growth is a chapter in the South's great growth during the past decade," Younts said. In that time, gasoline consumption alone in the six states we serve has increased about 100 per cent; automobile registration has climbed more than 50 per cent.

"We are pleased to be part of the economic and industrial expansions these figures reflect. By providing economical transportation for the fuels to provide so much of the energy the South will need in the future we hope to continue to grow along with it."



Pipe Line Celebrates Twenty-fifth Anniversary

A pipe line that has brought more than 10 billion gallons of petroleum products to the Chicago area celebrated its twenty-fifth anniversary during November. At an anniversary dinner held in Whiting, 38 Shell employees received watches in recognition of 25 years of pipe line service.

These veterans run Shell's products pipe line, an 8-in. diam system that carries 1,500,000 gal of petroleum products a day from Shell's Wood River refinery to a terminal at East Chicago. Twenty-two different grades of products—three grades of aviation gasoline, three grades of motor gasoline, kerosine, jet fuels, mineral spirits, solvents, and various fuel oils — all can be kept moving through at the same time, each refusing to mix with its neighbors as if walls existed between them. The reason is that the line is kept under pressure and products move in what engineers call high-speed turbulent flow.

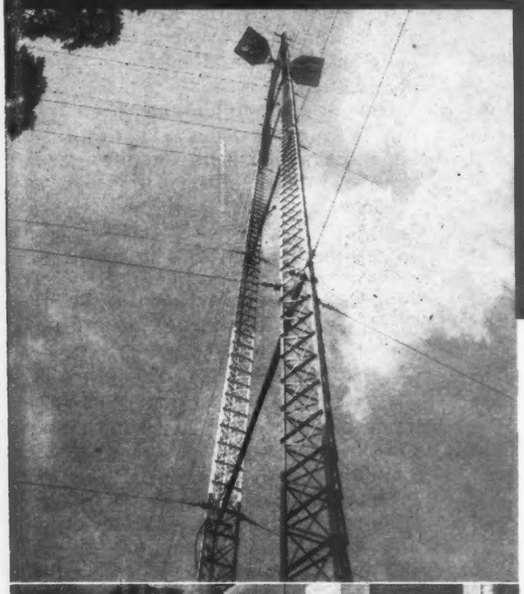
The necessary pressures are maintained by six pumping stations along the way. The first is at the Wood River refinery itself. Other are at Barnett, Auburn, DeWitt, Sibley, and Bradley. A terminal, at which products are taken from the line for central Illinois, is situated at Harrison.

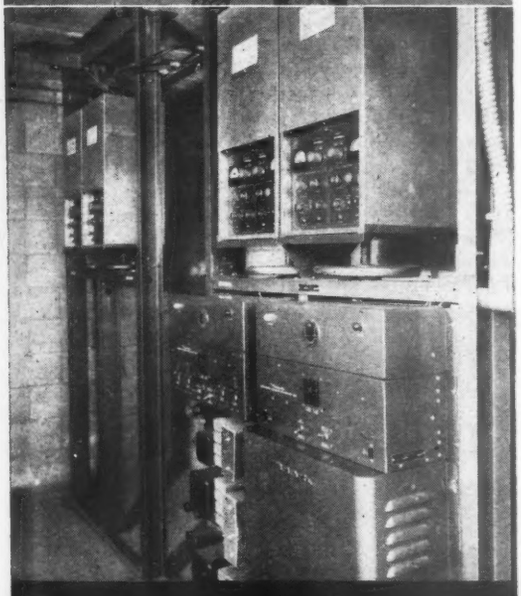
Supplying many great Lakes cities, as well as the greater Chicago market, the northernmost terminal—at East Chicago—sends out products by truck, train, and tanker. Besides distributing products, this terminal also has a research laboratory, where samples taken all along the way from Wood River to East Chicago are tested to guarantee that products have maintained Shell's rigid specifications.

According to V. K. Leonard, superintendent, the line was originally built to bring crude oil from the south to Shell's East Chicago refinery. But in 1940, when Shell consolidated refining operations at Wood River, the East Chicago plant was converted into one of the world's largest petroleum terminals and the pipe line began carrying finished products.

The entire pipe line system has a staff of about 250. Two-thirds of them have been with the Shell organization for ten years or more. The 38 employees honored at the anniversary dinner include two who have already retired on pensions. Next year an additional 26 employees will have completed 25 years' service.

21—Motorola microwave systems are in and working!





Including the world's first 1000-mile private operating system

Here is Experience that you can rely on!

Facing a healthy new demand for more serviceable and flexible communication facilities, responsible management turns to Microwave for the extension of communication facilities.

Use the Motorola Microwave circuit for telephone, teletype, telemetering, remote switching and general supervisory control applications.

Motorola is experienced in shaping the systems-design to meet the customers day-in-day-out operational problems.

More than 20,000 installations in the past ten years have proved the reliability of Motorola 2-way radio—and now more than 25,000 miles of Motorola Microwave operating Circuits have proved the unquestioned reliability of Motorola Microwave Communications.

Make your new plant truly *new* all the way with Motorola Microwave.

Write for free booklet "The Motorola Microwave Story" and incidentally a Motorola engineer is ready to assist you with generous and thoroughly competent information.

Partial List of Microwave Systems

Aeronautical Radio Incorporated
State of California
Pan American Pipeline Co.
Shell Pipeline
Panhandle Eastern Pipeline Co.
Texas Illinois Natural Gas Pipeline Co.
Mid-Valley Pipeline Co.
Brazos River Electric Transmission Cooperative
City of Dayton, Ohio
Michigan State Police

Motorola

Communications and Electronics Division
4545 Augusta Blvd., Chicago 51, Illinois

The Specialists in industrial radio communication systems

22 Years of Leadership in Mobile Radio

World's leading producers (twice as many as all others *combined*) of 2-way mobile radio. Microwave, carrier and control systems and general radio communication equipments.

Remember! *Experience Counts Especially in Microwave*

PIPE LINE PERSONALS

E. R. Osburn

E. R. Osburn, veteran pipe line company executive, is now operating as a consulting engineer for pipe line transportation of oil and gas. His headquarters are in Midland, Texas.

Osburn recently resigned as assistant general manager of The Texas Pipe Line Company and the Texas-New Mexico Pipe Line Company, with headquarters in Houston, and moved back to Midland.

He has already started work as a consultant, maintaining his office at his residence at 1202 Princeton Drive.

He will do consulting engineering for pipe line surveys; engineering and economic studies of oil, products and gas transportation problems; design and construction of crude gathering and main lines, and the promotion of projects for crude oil outlets.

Osburn first worked for The Texas Pipe Line Company in 1928. He did engineering work on the first 12-in. pipe line that was laid from Eunice, New Mexico, to Houston by that company.

He handled a variety of engineering and construction assignments for Texas Pipe Line, Texas-Empire Pipe Line Company, and Texas-New Mexico Pipe Line Company in various states and areas between 1928 and 1937, when he was made general superintendent of the Texas-New Mexico Pipe Line Company.

He moved to Midland in 1938 and lived there until 1946. During all of that period he was chief executive of Texas-New Mexico Pipe Line Company in the Permian Basin.

He was promoted to be assistant general manager of both The Texas Pipe Line Company and the Texas-New Mexico Pipe Line Company in 1946 and at that time moved to Houston.

Osburn also was a member of the board of directors of both companies while he served as assistant general manager of these concerns.

During the last five years he has been concerned with the engineering and construction of the Basin Pipe Line System from Jal, New Mexico, to Cushing, Oklahoma; a products system from Port Arthur to Dallas, and the revamping of several old pipe line properties to accomplish increased capacities.

He has also prepared a number of detailed economic studies of pipe line projects in both the United States and Canada.

L. L. Tarne has been named northern division superintendent of the Pipe Line Department of General Petroleum Corporation, according to an announcement by **George Supple,** vice president and director of pipe lines.

C. A. McDonald has been appointed assistant division superintendent. Both men will make their headquarters at Taft, California.

Tarne, who spent the first 20 of his 29 years with General Petroleum in the Lebec station of the company's Tehachapi pipe line, has been assistant superintendent of the southern division for the last five years.

McDonald, who has been with General Petroleum since 1938, has been safety supervisor.

John B. Craven, chief engineer of The Peoples Gas Light and Coke Company, Chicago, Illinois, recently retired from active service under the company's annuity plan.

P. E. Busch has been named chief engineer of C. E. Wilson Construction Company of Houston and Kansas City. Busch for the last two years has been assistant superintendent of measurement for Texas Eastern Transmission Corporation at Shreveport, Louisiana, and prior to that time was chief corrosion engineer for Great Lakes Pipe Line Company at Kansas City. During the war, Busch was construction foreman, Army Engineer Petroleum Distribution Units, building and operating products pipe lines and terminals in North Africa and Italy.

L. R. "Dick" Welch, junior engineer, has been transferred by Texas Eastern Transmission Corporation from Division 1 to assume new duties with the plans and research department of the company in the general offices at Shreveport, Louisiana.

Russell Kranzfelder has been transferred from Division 111 to the engineering department in the general offices.

Alton T. Tylerif is the new division engineer of Division IV. He formerly was in the general office at Shreveport.

Loren F. Kahle, former president of the Interstate Oil Pipe Line Company and assistant to the pipe line advisor of the Standard Oil Company (New Jersey), has been named deputy coordinator in the new Office of Coordinator of Transportation Activities of Jersey Standard.

The new office, which will begin operations January 1, will serve as counsel to Jersey's domestic and foreign affiliates seeking assistance in working out arrangements to meet their oil and transportation requirements. Head of the new office will be **John J. Winterbottom,** executive vice president of Esso Shipping Company.

Principal offices of the transportation coordinator will be in New York and contacts with affiliates in the Eastern Hemisphere will be maintained through a London office.

Kahle formerly was president of the Interstate Oil Pipe Line Company and executive vice president of Interprovincial.

Talking it over at the API meeting in Chicago: E. M. Kemler, left, University of Minnesota; Bill Wilkins, Gulf Oil Corporation, and Tom Blanton, W-K-M Company.

Now Turbocharged

TO PRODUCE GREATER HP AT THE SAME MEDIUM SPEEDS

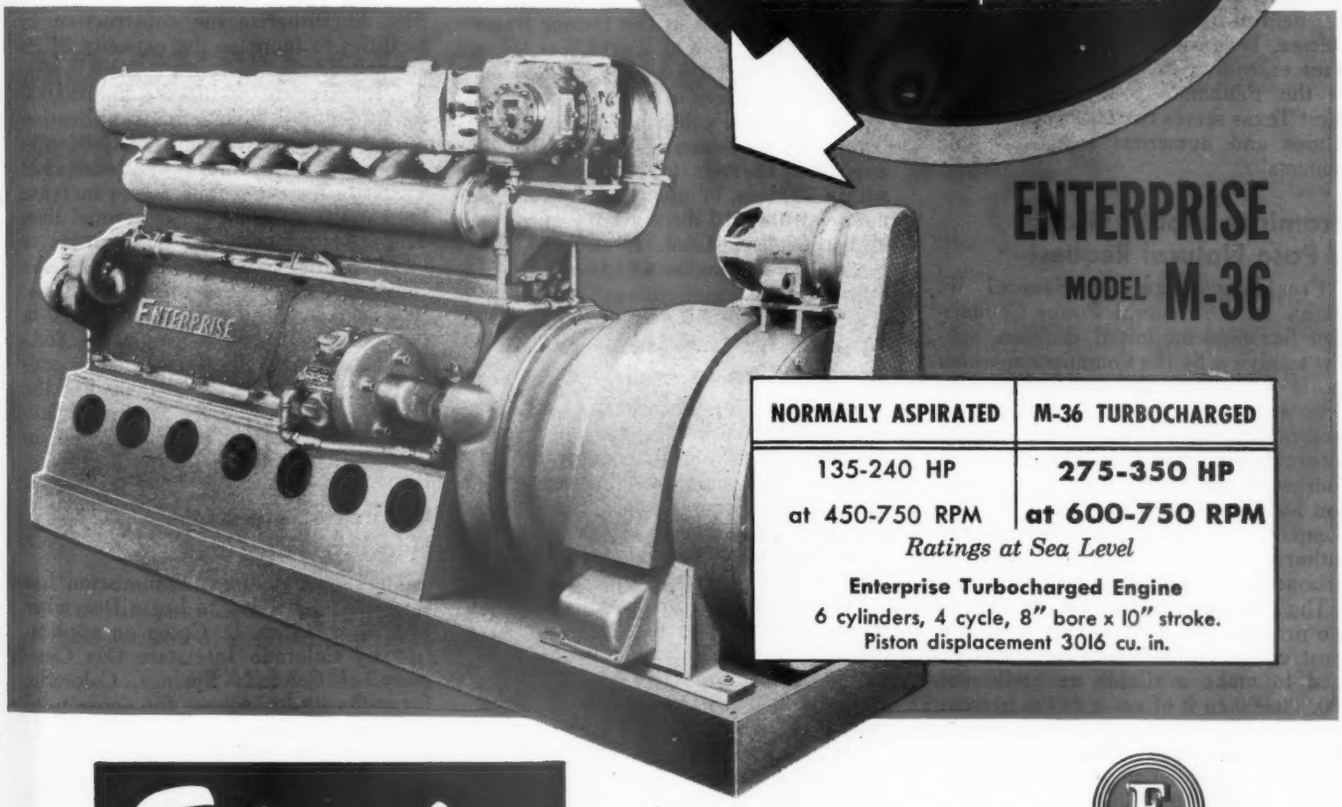
Here's the diesel specifically designed for Turbocharging.

Together with this advancement in low power heavy duty engines is the unmatched efficiency made possible through Enterprise intercooling. This development permits the engine to maintain uniform mean cycle temperatures comparable to normally aspirated engines—without increasing thermal stresses and bearing loads.

Get complete information today. See why Enterprise offers the best in heavy-duty, continuous service, medium speed diesels—for every stationary power use.

ENTERPRISE OFFERS ALL THESE OUTSTANDING FEATURES IN TURBOCHARGED DIESELS OF THE LOW HP RANGE

- Solid injection, individual fuel pumps
- Enterprise intercooling
- Efficient performance on low cost fuels
- Low fuel consumption
- Smooth, quiet, vibration-free operation
- Integrated design, easy accessibility
- Clean running, low maintenance
- Rugged construction, continuous round-the-clock operation
- Front and rear end power take-offs



ENTERPRISE MODEL M-36

NORMALLY ASPIRATED	M-36 TURBOCHARGED
135-240 HP at 450-750 RPM	**275-350 HP at 600-750 RPM**

Ratings at Sea Level

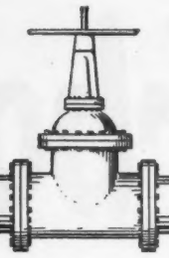
Enterprise Turbocharged Engine
6 cylinders, 4 cycle, 8" bore x 10" stroke.
Piston displacement 3016 cu. in.

Enterprise DEPENDABLE Diesels

The Choice of Power Experts

ENTERPRISE ENGINE & MACHINERY CO.
A Subsidiary of General Metals Corporation
18th & Florida Streets, San Francisco 10, California

PIPE LINE PROJECTS



West Texas Gas to Add to Facilities

West Texas Gas Company, of Lubbock, Texas, has asked the Federal Power Commission to authorize the construction of approximately 32.5 miles of new pipe line and compressor station additions totaling 2010 hp on its natural gas transmission system in Potter and Randall counties, Texas.

The facilities, estimated to cost $1,636,145, would increase the capacity of the company's pipe line system by about 24,000,000 cu ft a day, providing a new total system capacity of approximately 135,000,000 cu ft daily.

The company also is proposing to salvage 25 miles of existing line, which would be laid as a loop to its existing line south of its McSpadden compressor station, which is in Randall County.

The company's system extends from the Fritch area of the Texas Panhandle gas field to the vicinity of Midland and Odessa, Texas, with laterals and supply lines extending to 47 cities and towns in the Panhandle-South Plains area. West Texas serves two other utility companies and numerous industrial consumers.

Examiner Would Grant El Paso Natural Request

Presiding Examiner Samuel W. Jensch of the Federal Power Commission has filed an initial decision, subject to review by the Commission, which would authorize El Paso Natural Gas Company of El Paso, Texas, to construct facilities to expand the capacity of its natural gas transmission system in the Southwest, but would deny an application by Nevada Natural Gas Pipe Line Company, of Las Vegas, Nevada, for authority to build a pipe line from Arizona to Nevada.

The examiner's decision authorizes two projects by El Paso. One is for the construction of facilities that would be used to make available an additional 100,000,000 cu ft of gas a day to present customers on its system in Texas, New Mexico, and Arizona. This construction program, estimated to cost $22,950,000, includes about 10.4 miles of 30-in. main line loop and 37,160 hp in new and existing main line compressor stations. The examiner found that certain other field and gathering facilities included in the project did not require FPC authorization.

The other El Paso project includes a construction program, estimated to cost $1,038,404, to increase the capacity of its facilities to serve the Phoenix, Chandler City, and Mesa, Arizona, area by 67,000,000 cu ft a day, making a total capacity of approximately 143,000,000 cu ft. Temporary authorization for these facilities was granted by the FPC in October, 1950.

The examiner denied Nevada Natural's proposed project because the company, he said, had failed to show the availability of natural gas for the service it proposed to render. Nevada Natural is seeking a supply of gas for the project from the El Paso system.

Nevada Natural's proposed project, estimated to cost $2,331,350, is a 114-mile pipe line for the transportation of natural gas for sale in Henderson, Boulder City, and Las Vegas, Nevada. The proposed line, extending from a point near Topock, Arizona, to Las Vegas was intended to serve Stauffer Chemical Company, Titanium Metals Corporation, and other manufacturers operating portions of the former Basic Magnesium project of World War II, as well as residential, commercial, and industrial consumers in southern Nevada.

The examiner's decision is subject to review by the commission, either upon appeal by parties to the proceedings within 20 days, or upon the FPC's own motion within 10 days after expiration of the 20-day period. If no review is initiated, the decision will become final after 30 days.

Applies for Gas Line Construction in East

New York State Natural Gas Corporation, of New York City, has applied to the Federal Power Commission for authority to construct approximately 104.7 miles of pipe line in Pennsylvania and New York and to install an additional 2420 hp at two existing compressor stations in Pennsylvania.

Purpose of the proposed facilities, which are estimated to cost about $6,084,900, is to enable the company to deliver gas in quantities sufficient to meet the estimated requirements of its customers, the application states.

The 104.7 miles of pipe line would be constructed in five sections, four of which would parallel existing transmission lines, with the fifth replacing an existing line. The new sections of line would be in Westmoreland, Armstrong, Tioga, and Potter counties, Pennsylvania, and in Wyoming, Onondaga, and Cayuga counties, New York. The additional compressor horsepower would be installed at stations in Westmoreland and Tioga counties.

FPC Hearing Set on $96,000,000 Construction

The Federal Power Commission will hold a hearing beginning March 4 in Washington, D. C., on four applications involving the proposed construction of pipe line facilities which together would carry an additional 300,000,000 cu ft of natural gas per day to markets in southern, central, and northern California.

Two of the applications are by El Paso Natural Gas Company, of El Paso, Texas, which is seeking authorization to build facilities to transport the additional gas to the Arizona-California border, where 150,000,000 cu ft would be delivered to Pacific Gas and Electric Company, of San Francisco, California, and 150,000,000 cu ft to Southern California Gas Company and Southern Counties Gas Company of California, both of Los Angeles, California.

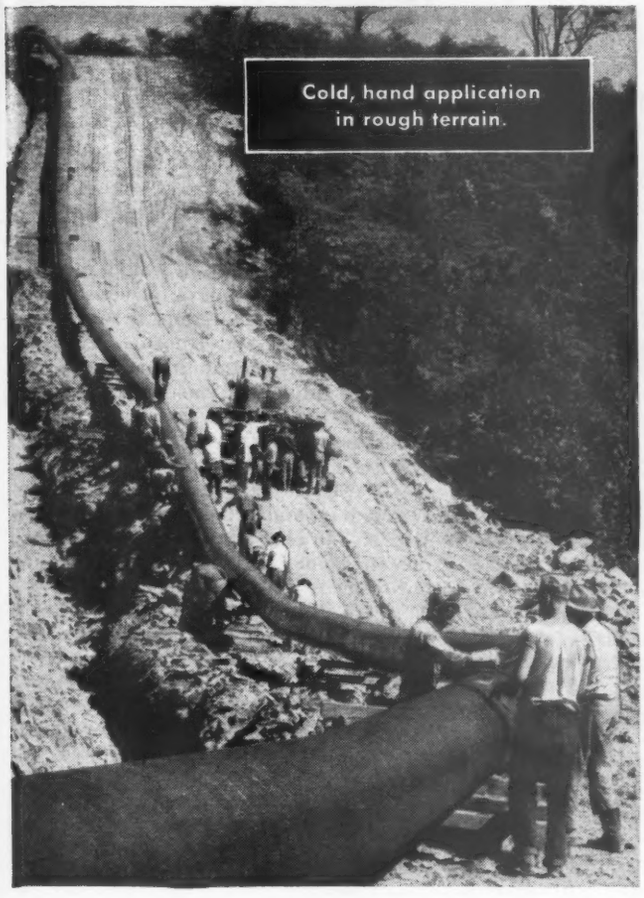
Pacific Gas, in turn has asked the FPC to authorize the construction of facilities to increase the capacity of its Topock (Ariz.)-Milpitas (Calif.) pipe line to carry the additional 150,000,000 cu ft per day. The fourth application was filed jointly by Southern California and Southern Counties, and requests authority for the companies to increase the capacity of their jointly-owned line, from the Arizona-California border to the Los Angeles area, to transport the additional gas received from El Paso.

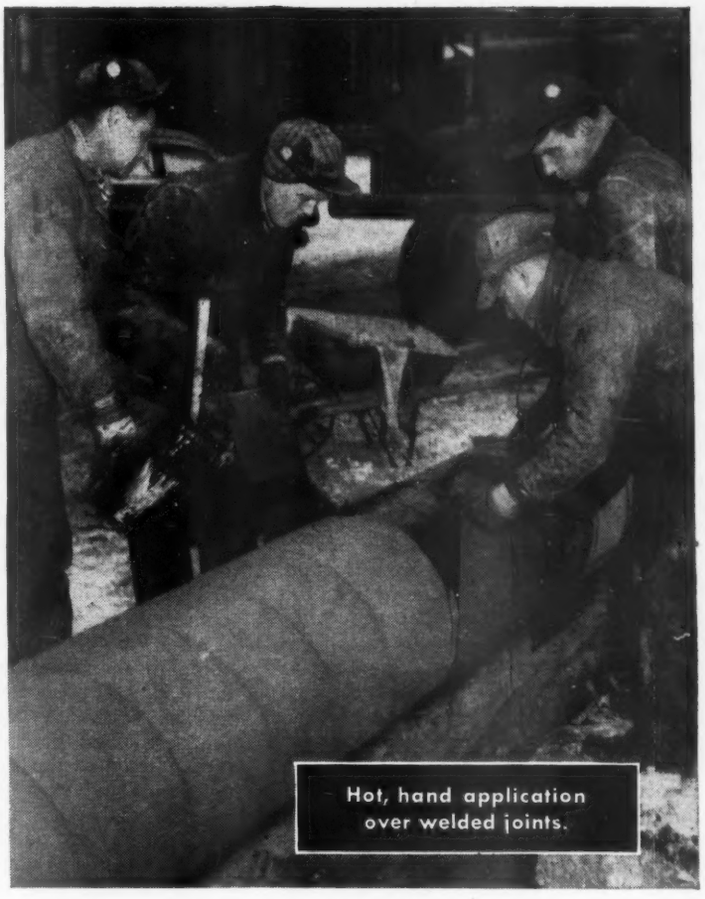
Total cost of the facilities proposed in the two El Paso applications is $68,690,000. The Pacific Gas project is estimated to cost about $19,391,000, and the facilities to be built by Southern California and Southern Counties have an estimated cost of $7,767,525.

Colorado Interstate Hearing Scheduled

The Federal Power Commission has scheduled a hearing to begin December 3 in Washington, D. C., on an application by Colorado Interstate Gas Company, of Colorado Springs, Colorado, for authority to increase the capacity of its recently-authorized 216-mile natural gas pipe line extending from the West Panhandle gas field in Texas to a point in Cheyenne County, Colorado.

The proposed construction program, estimated to cost $3,453,105, would help the company to meet the anticipated needs of its customers in the Rocky Mountain market area, Colorado Interstate says. The project involves the proposed installation of additional compressor horsepower and the construction of loop and lateral pipe lines.





NO-OX-ID RUST PREVENTIVE MATERIALS
add life time to pipe lines

For long-term, low-maintenance underground service, NO-OX-ID and NO-OX-IDized Wrappers can be applied by hand as shown above. This method is especially adapted to application over rough terrain, on short lines or congested areas and on field joints after welding.

COLD METHOD: A pliable, plastic, cold NO-OX-ID is rubbed on to 1/32" thickness.

NO-OX-IDized Wrapper is applied spirally as a shield, keeping the NO-OX-ID in intimate contact with the pipe—providing a tight seal against moisture and preventing abrasive damage. Then a final coating of NO-OX-ID is brushed on.

HOT METHOD: A length of NO-OX-IDized Wrapper is used as a granny rag to apply hot NO-OX-ID. The wrapper is then sealed to the coating around the pipe for permanent protection.

Consult your Dearborn Engineer for the NO-OX-ID combination and method of application best suited to protect your next pipe job.

DEARBORN CHEMICAL COMPANY
Merchandise Mart Plaza • Chicago 54, Illinois

GET THIS PIPE LINE BOOK

This informative illustrated book, "Protecting Underground Pipe from Corrosion with NO-OX-ID and NO-OX-IDized Wrappers," describes the hand application, traveling machine and stationary machine methods. Also contains coverage tables on each. The coupon is for your convenience.

Dearborn Chemical Company
Merchandise Mart Plaza, Dept. PE
Chicago 54, Illinois

Please send my copy of "*Protecting Underground Pipe from Corrosion With NO-OX-ID and NO-OX-IDized Wrappers.*"

Name.....

Company.....

Address.....

City.....Zone....State.....

Dearborn
Reg. U. S. Pat. Off.

NO-OX-ID
IRON + OX = RUST

THE ORIGINAL RUST PREVENTIVE

Tennessee Gas Withdraws Application to Export

Tennessee Gas Transmission Company, of Houston, Texas, has filed with the Federal Power Commission a notice of withdrawal of its application in which it was seeking authority to increase the capacity of its pipe line system by 115,000,000 cu ft of natural gas per day for ultimate delivery to markets in Ontario, Canada.

Tennessee said that it is not prepared at this time to submit the exhibits required under the FPC's rules, and requested that the withdrawal of the application be authorized without prejudice to the filing at a later date of another application for authority to export natural gas to Canada.

The proposed construction program covered by the application was estimated to cost $47,403,000. The project included a line extending from Buffalo, New York, to a point on the U. S.-Canadian border near Niagara Falls, New York. The 115,000,000 cu ft of gas was to be delivered to Niagara Gas Transmission Limited, a newly formed Ontario corporation controlled by Consumers' Gas Company of Toronto, for resale to Consumers for distribution in Toronto and for resale to other markets in Ontario.

Under the FPC's rules, the notice of withdrawal will become effective after 30 days unless otherwise ordered by the commission.

GENERAL
PIPE LINE
CONTRACTORS

Personal Supervision on
Construction of Your
Pipe Lines • Water Lines
Sewer Lines • Excavations
Salt Water Disposals

TROJAN
CONSTRUCTION CO.
INCORPORATED
1416½ N. ROBINSON
OKLA. CITY, OKLA. PH. 2-7696
WAREHOUSE PHONE 6-1430

FPC Grants a Part Of Texas Gas' Request

The Federal Power Commission has authorized Texas Gas Transmission Corporation, of Owensboro, Kentucky, to construct a 189-mile pipe line in Louisiana, but other proposals by the company, including sales to the Tennessee Valley Authority and to expand its natural gas transmission system, were denied.

The commission, finding that Texas Gas had failed to show that it has an adequate supply of gas, rejected the company's plans to build about 405 miles of loop line on sections of its existing systems between Bastrop, Louisiana, and Hardinsburg, Kentucky, together with about 17,260 hp of additional compressor capacity, and at the same time denied an application for the construction of a new 3960-hp compressor station near Shreveport.

The 189-mile, 26-in. line that was authorized by the FPC will extend from Acadia Parish to a connection with the company's existing facilities in Morehouse Parish, all in Louisiana. The commission said that construction of the line, estimated to cost about $14,000,000, will offset the present gas supply deficiency on Texas Gas System, which now has a capacity of about 705,000,000 cu ft per day but only 652,500,000 cu ft available to the company.

The commission also authorized Texas Gas to construct a metering and regulating station for the direct sale of up to 6,000,000 cu ft of natural gas per day on an interruptible basis to a new plant of the Mathieson Hydrocarbon Chemical Corporation at Brandenburg, Kentucky. Estimated cost of these facilities is $6500.

Texas Gas previously had received temporary authorization from the FPC for the construction of the 189-mile Louisiana line and the station for service to the Mathieson plant.

In addition to the actions on the Texas Gas applications, the commission denied an application by United Gas Pipe Line Company, of Shreveport, Louisiana, which was proposing to sell gas to Texas Gas. The commission found that United has not shown that it has the facilities necessary to enable it to make the proposed increased deliveries, together with deliveries proposed to be made to other customers.

Emphasizing that the denial is without prejudice, the Commission said that the applicants may submit new proposals buttressed by showings to meet the requirements of the Natural Gas Act. "Indeed," the commission asserted, "we are convinced that in these circumstances the public interest will best be served by the filing of such applications, for they can readily be adjusted to the demonstrated market needs of the entire area served by Applicant and can, therefore, be disposed of in a more clear-cut and expeditious fashion that would be likely if efforts were made to patch up in a reopened proceeding the many deficiencies of the present proposals."

Texas Pipe Line To Expand System

Projects to modernize and expand the crude oil pipe line system of The Texas Pipe Line Company from Wichita Falls to East Houston, Texas, have been announced by R. B. McLaughlin, president.

Following approval by the Petroleum Administration for Defense, the company disclosed that it would award a contract within 30 days for construction of a 195-mile 16-in. line between Corsicana, Texas, and Houston, Texas. It will also construct additional tankage at Wichita Falls and modern pump stations at Chico and Corsicana, Texas. Completion of this project is expected by June 1, 1952.

The Texas Pipe Line Company's existing 8-in. and 10-in. lines between Corsicana and Humble will be taken up and reconditioned for use in other company projects.

California Companies Amend Application

Southern California Gas Company and Southern Counties Gas Company of California, both of Los Angeles, California, have filed an amendment to their application with the Federal Power Commission to construct pipe line facilities to carry an additional 150,000,000 cu ft of natural gas per day to markets in southern California.

The two companies are now proposing to build about 45 miles of 30-in. line in lieu of the 87 miles proposed in the original application. The 45 miles of line will parallel sections of the companies' existing pipe line that extends from the Arizona-California border to a point near Los Angeles. A 39-mile section of line would be installed eastward from the terminus of the company's existing loop line at Whitewater, California, and the second section, about 6 miles long, would be installed between the Blythe, California, compressor station and the California-Arizona boundary. The proposed installation of two 1760 hp compressors at the Blythe station was unchanged from the original application.

Estimated cost of the facilities as now proposed is $5,386,000, compared with $7,767,525 in original application.

The companies said they were making the changes in the proposed facilities because they are unwilling to sign the type of common carrier stipulation now required by the Secretary of the Interior from owners of gas pipe lines crossing public lands. A large portion of the originally proposed 87 miles of line would have crossed public lands.

A commission hearing has already been set to begin March 4 on the companies' proposal. The application will be heard with others involving natural gas service in California, including El Paso Natural Gas Company's plans to build facilities to deliver the 150,000,000 cu ft of gas per day day to Southern California and Southern Counties.

Depleted Gas Fields For Gas Storage

Cities Service Gas Company, of Oklahoma City, Oklahoma, has received Federal Power Commission authorization for the development and utilization of two depleted gas fields in Kansas for the underground storage of natural gas.

Under the authorization, the company will acquire the Colony field in Anderson County and the McLouth field in Leavenworth and Jefferson counties, and construct facilities necessary to utilize the fields for gas storage. In addition, Cities Service was authorized to replace approximately 10 miles of double 16-in. lines with a single 26-in. line between its Welda and Ottawa compressor stations in Franklin County, Kansas.

The facilities are expected to increase the company's maximum daily available delivery supply by approximately 120,000,000 cu ft of gas, enabling it to meet continuing increased demands for firm service in the Kansas City area and providing greater flexibility throughout its system.

The storage fields are expected to provide an ultimate daily delivery capacity of 60,000,000 cu ft each. The Colony field is expected to be ready for operation by the 1952-53 heating season and the McLouth field by the 1953-54 heating season.

Estimated overall capital cost of the storage fields is $3,052,627, and the estimated net cost of building the proposed 10 miles of 26-in. line is $419,000.

Loops Will Increase Capacity Service Line

Construction of nearly 30 miles of 20-in. crude oil pipe line for the Service Pipe Line Company, began at La Plata, Missouri, October 22.

The line, in two sections, will be loops on the company's present multi-line system across Missouri, according to H. G. Mariner, Carrollton, division manager for the company in Missouri.

When completed about December 15, the new loops will enable the company to increase crude oil deliveries in the St. Louis and Chicago areas by about 17,000 bbl per day, Mariner said.

"This is an example of what the oil industry is doing to meet the increasingly heavy civilian and military demands for more petroleum products," Mariner pointed out. "The project has been approved by the Petroleum Administration for Defense."

The contractor, G. G. Griffis Construction Company, Inc., of Tulsa, Oklahoma, is working in a southwesterly direction from LaPlata on the first section. This is 12.8 miles of line from the company's LaPlata station to a point west of the Chariton river, all in Macon County.

In crossing the river, deep excavations will be made in order to prevent washouts, Mariner said.

The second section, 16.8 miles of 20-in. line, is being built from Odessa junction in Lafayette County, through Johnson and Jackson counties to Pleasant Hill junction in Cass County. Both sections of the line will parallel existing lines.

D. G. Doyal, Service Pipe Line Company connection foreman at Carrollton, is chief inspector for the company, Mariner said. He is being assisted by six inspectors and a field clerk.

Texas Pipe Line to Lay Gulf Coast Line

Projects to modernize and expand the oil pipe line system of The Texas Pipe Line Company in the Gulf Coast area were announced by R. B. McLaughlin, president. The company is a wholly-owned subsidiary of The Texas Company.

Following approval by the Petroleum Administration for Defense, the company disclosed that it would award a contract for construction of a 220-mile 22-in. pipe line between Houma, Louisiana, and Port Arthur, Texas. It will also construct a new 12¾-in. pipe line from Houma to Cocodrie, Louisiana, a distance of 31 miles, and a gathering system to serve the Bay St. Elaine, Lake Barre, Lake Pelto, and Caillou Island oil fields in the Terrebonne Bay area of Louisiana. Completion of the 22-in. line is expected by July 1, 1952.

The Texas Pipe Line Company's existing 8-in. and 10-in. line from Houma to Port Arthur will be extended to Baton Rouge, Louisiana, and converted into a products pipe line system.

Completion of the new 22-in. pipe line will provide an outlet for increased production in the four producing fields to which the new gathering line system will be extended, according to McLaughlin.

Short Gas Line to be Constructed in Virginia

The Federal Power Commission has authorized Southwestern Virginia Gas Transmission Company, of Martinsville, Virginia, to construct a 17-mile pipe line for the transportation of natural gas for ultimate distribution in the Martinsville area.

Southwestern's line will connect with Transcontinental Gas Pipe Line Corporation's system just north of the North Carolina-Virginia state line.

A commission examiner last May filed an initial decision dismissing Southwestern Virginia Transmission's application, which at that time sought an order directing Transcontinental to supply gas for transportation and sale for resale to the Martinsville affiliate. Transmission subsequently amended its application by proposing to build the line for the sole purpose of transporting gas for the account of its affiliate rather than purchasing the gas from Transcontinental and then reselling it to the distributing company as previously proposed.

Estimated cost of the proposed facilities is $220,378.

Service to Lay Line in Williston Basin Area

The first crude oil pipe line in the North Dakota area of the Williston Basin is being planned for early construction by the Service Pipe Line Company, a wholly owned subsidiary of Standard Oil Company (Indiana).

J. L. Burke, president of the company, states that a 14-mile gathering system will be built in the vicinity of Tioga to transport the production in the area. The crude, Burke said, will be pumped to a tank car loading rack at Tioga.

A spur track on the Great Northern Railroad will be built at Tioga. Service Pipe Line will erect a 12-car loading rack and two 5000-bbl tanks there. The necessary pumping equipment to move the oil will be installed on the leases and also at the loading rack.

"We are making every effort," Burke said, "to complete all preliminary arrangements in time to have our facilities constructed and in operation before severe cold weather."

Several gagers and deliverymen will be stationed at Tioga.

Service Pipe Line Company will add an eleventh state to its operating areas when the North Dakota project is completed.

Gas Storage Facilities Given FPC Approval

The Federal Power Commission has authorized Michigan Gas Storage Company, of Jackson, Michigan, to construct and acquire natural gas pipe line and storage facilities in Michigan, which will be used to handle additional gas supplies during the coming winter.

The order authorizes Michigan Gas to acquire and operate the Riverside gas field, in Missaukee County, for development as a natural gas storage area. In connection with the field, the company will acquire an existing 10-mile line and other facilities owned by Consumers Power Company, also of Jackson.

Michigan Gas will build approximately 78 miles of 24, 22, and 16-in. line extending from Laingsburg Junction to a point near Pontiac and Mt. Clemens, with 17 miles of lateral lines into Consumer's Southeast Division in southeastern Michigan. Other facilities to be constructed include about 30 miles of 26-in. loop line between Laingsburg and Mt. Pleasant Junction, and an additional 7400 hp in compressor capacity at the Muskegon River compressor station.

The facilities are to be used for the receipt, transportation, storage, and delivery of additional natural gas that Michigan is to receive from Panhandle Eastern Pipe Line Company. The gas will be delivered to Consumers, which serves markets in central and southeastern Michigan.

Total estimated cost of the acquisition and construction is $10,866,000.

Temporary authorization for the construction of a portion of the facilities was granted by FPC last May.

With the PIPE LINE CONTRACTORS

Anderson Brothers Corporation, 707 North Drennan Street, Houston, Texas, has been awarded contracts for three "jobs" by Texas Eastern Transmission Corporation, totaling 217 miles and extending from the Ohio River near Portsmouth, Ohio, to Connellsville, Pennsylvania. Job No. 8 extends from the north side of the Ohio River 77 miles to a point near Amesville, Ohio. Job No. 9 is from the latter point 74 miles to the Ohio-West Virginia crossing of the Ohio River. Job No. 10 extends from the second crossing of the Ohio River to a point near Connellsville, a distance of 66 miles. The pipe is 30 in. in diam. Additionally, 25 miles of 30-in. has been subcontracted from Oman Constructon Company in Tennessee and 35 miles of 30-in. from N. A. Saigh Company in Kentucky, and 30 miles of 30-in. in Tennessee has been contracted.

On the Algonquin Gas Transmission Company project, approximately 95 miles of 24-in. pipe is being laid from Hartford, Connecticut, to Boston, Massachusetts. One spread has its field headquarters at Mendon, Massachusetts, where Rusty Killingsworth is superintendent. Another has its offices at Mansfield Center, Connecticut, where Earl Saulsman is superintendent and Frank Hindman office manager.

Williams Brothers Company, National Bank of Tulsa Building, Tulsa, Oklahoma, has contracted to install three river crossings for Texas Eastern Transmission Corporation. These are the Hocking, Muskingum, Monongahela, and Ohio.

The East Ohio Gas Company job is nearing completion and should be wound up early in December. This is 65 miles of 26-in. from Cleveland to Petersburg, Ohio. The field office is at Revenna with O. R. Mitchell superintendent.

The foreign division of Williams Brothers is laying two lines in Venezuela. For Shell Caribbean Petroleum Company, 160 miles of 30-in. is being laid from Palmerejo, near Maracaibo, to Punta Cardon.

For the Venezuelan Atlantic Transmission Corporation, 195 miles of 10, 12, and 16-in. pipe is being laid from Las Mercedes to Caracas. This is a gas line. Marvin Jones, with headquarters in Caracas, is in charge of both jobs.

Oklahoma Contracting Company, 6512 Hines Boulevard, Dallas, Texas, is doing considerable work for the United Gas Pipe Line Company. A spread under M. E. "Panama" Shiflett has just finished laying 36 miles of 30-in. on an 86-mile section between Pierce and Refugio, Texas. A second spread under Raymond Law has just started on the remaining 50 miles (November 20). Law's spread is working out of Victoria and Shiflett's out of El Campo. The latter, working from the same base, has now begun work on 320 miles for United between Agua Dulce and Goodrich, Texas. Except for 54 miles of 26-in. this also is 30-in. pipe. When it completes the job it is on now, Law's spread will move over on this work.

Oklahoma still has in progress the installation of a crossing under the Tennessee River for Texas Eastern Transmission Corporation at Florence, Alabama. Paul Halbert and Aldress Kilgore are in charge.

Eastern Pipe Line Contractors, 1801 Mercantile Bank Building, Dallas, Texas, had laid approximately 40 miles of pipe and cleared 52 miles of right-of-way (November 17) on the Texas Eastern Transmission Corporation job, which consists of 76 miles from Florence, Alabama, to Columbia, Tennessee. The contractor is now out of rock, which has slowed down the work, and the going should be easier from here on out. J. H. Schumacher, Jr., is superintendent and Fred Harwell and J. D. Jones are in the office, which is at Lawrenceburg, Tennessee.

Smith Contracting Corporation, 205 Northwest Seventh Street, Fort Worth, Texas, having completed 57 miles of 10-in. for Service Pipe Line Company between Throckmorton and Haskell, Texas, is maintaining its field office at Haskell to lay some lateral lines for the same company. The installations will be at Aspermont and will consist of about 3 miles of 4-in. Herb Smith will be in charge as superintendent with Jim McKnight spreadman.

Oman Construction Company, Inc., Box 146, Nashville, Tennessee, has the principal contract to lay 79.5 miles of 30-in. pipe line for Texas Eastern Transmission Corporation, extending from Columbia, Kentucky, to Hartsville, Tennessee. Part of the job has been subcontracted to Anderson Brothers Corporation. Field headquarters for Oman are at Columbia. Arky Hobson is superintendent and T. J. Hopkins office manager.

O. R. Burden Construction Corporation, 6702 East 21st Street, Tulsa, Oklahoma, is laying pipe between Salisbury, Missouri, and Wood River, Illinois, on the Platte Pipe Line Company system. Altogether, the contractor will lay 280 miles, from the Missouri River, near St. Joseph, Missouri, to Wood River. Presently, the field office is at Mexico, Missouri, for the spread under Barney Hall, and of which Howard Smith is office manager. Another spread has its headquarters at West Alton, Missouri. A. B. Haynes is superintendent and Walt Hill office manager.

Mahoney Contracting Company, 2360 North Grand Avenue, Lansing, Michigan, pulled half of the the Gulf of Coro crossing in Venezuela for Shell Caribbean Petroleum Company and then had to shut down. Work has started up again, however, and the contractor also is laying the Lake Maracaibo crossing. The Coro crossing consists of single 4-mile, 30-in. line, whereas Maracaibo will be double 20-in. lines, each 5 miles long. Angelo Tavernaro is in charge of the jobs.

Work is underway on 34 miles of 4 and 6-in. for the Simrall Corporation between Beaverton and Rose City, Michigan, and a 15-mile takeup job also is being done for this company between Gladwin and Beaverton. Ralph Bucher is the superintendent.

For Michigan Gas Storage Company, 95 miles of loops are being laid between Laingsburg Junction, Mt. Clemens, and Pontiac, Michigan. Pipe size is 8, 12, 16, 20, 22, and 24-in. The field office is at Clarkston, Michigan. Barney Finnerty is superintendent.

For Texas Eastern Transmission Corporation, 100 miles of 30-in. is being constructed from the Kentucky River near Ford, Kentucky, to the Ohio River near Portsmouth, Ohio. Henry Mogg is superintendent. The field office is at South Shore, Kentucky.

Trojan Construction Company, 1416½ North Robinson, Oklahoma City, Oklahoma, is completing the 50 miles of 30-in. between Ford and Moorhead, Kentucky, for Texas Eastern Transmission Corporation. Charles T. "Swede" Tillotson is superintendent.

N. A. Saigh Company, Inc., Suite 531 Majestic Building, San Antonio, Texas, is completing 80 miles of 30-in. for Texas Eastern Transmission Corporation, from Columbia, Tennessee, to Boonsboro, Kentucky. The field office is at Danville, Kentucky. Carl Doyle is superintendent, Raymond Doyle spreadman, James E. Gray office manager, Jesse Cobb chief inspector, Carl Avrett welding foreman, John Cain doping, and Charley Warren pipe.

Associated Pipe Line Contractors, Inc., 3272 Westheimer Road, Houston, Texas, is laying approximately 100 miles of 20, 24, and 26-in. pipe line for United Gas Pipe Line Company, from Napoleonville, Louisiana, to the New Orleans area. The field office is at Morgan City, L. H. Gray is superintendent and Ralph Herwig office manager.

Somerville Construction Company, Ada, Michigan, is finishing up 66 miles of 10-in. for Michigan Gas Utilities Company between Marshall and Sturgis, Michigan. Pat Mask is superintendent and Jim Godwin spreadman.

Ray L. Smith and Son, Inc., Hazlett Building, El Dorado, Kansas, has contracted to take up, recondition, and relay the 6-in. products line between Augusta, Kansas, and Kansas City, Missouri, of Socony-Vacuum Oil Company, Inc., White Eagle Division.

Jayhawk Construction Company, Inc., P. O. Box 68, Great Bend, Kansas, began laying 8 miles of 6-in. pipe for the Kaw Pipe Line Company on November 19 near Ellinwood, Kansas. As soon as this job is completed work will begin on 13.55 miles of 22-in. near Susank, Kansas, for the same company. F. A. "Tex" Faler is general superintendent, Richard Berkley office manager, Morgan Blair material man, M. A. Nichols pipe foreman, W. M. "Pete" Gunter paint foreman, and H. G. "Racehorse" Miller lowering-in foreman.

R. H. Fulton and Company, P. O. Box 1526, Lubbock, Texas, has moved its spread to Perryton, Texas, on the Panhandle Eastern Pipe Line Company job, consisting of 124 miles of 20, 24, and 26-in. loops between Sneed, Texas, and Olpe, Kansas. M. L. Boyd is superintendent.

The contractor recently completed 250 miles of 20-in. between Kit Carson, Colorado, and the Canadian River north of Amarillo, Texas, for Colorado Interstate Gas Company.

Fulton has laid a part of its 433-mile section on the Platte Pipe Line Company system, but has been hampered due to lack of pipe. The section is from Casper, Wyoming, to Brule, Nebraska. A. A. Carrigan is superintendent and D. G. Wagner manager of the office, which is at Wheatland, Wyoming.

River Construction Corporation, P. O. Box 9127, Fort Worth, Texas, is at work on 90 miles of pipe line between Orange and Houston, Texas. Except for approximately 5 miles of 26-in. on the Orange end, the pipe is of 20-in. diam. At present, work is on the 26-in. The field office is at 3000 Commerce Street, Port Arthur. J. T. "Borger Red" McMenamy is spreadman and Q. B. Davis, Jr., office manager.

Also for United, a total of 255 miles of 20, 24, and 30-in. is being laid from Napoleonville Junction, Louisiana, to Kosciusko, Mississippi. "Red" Tatom's spread, working from Hammond, Louisiana, will complete 55 miles of 30-in., from the Mississippi River to the Louisiana-Mississippi state line, about December 10. A. L. Price is manager of the field office.

Jim Reid's spread is now working on 23.6 miles of 20-in. from Week's Island Junction to Bayou Sale. Headquarters have been set up at Jeanerette, Louisiana.

Merle Tatom and his gang have completed the section from the Mississippi state line to McComb, Mississippi, and are now laying north from McComb toward Jackson. Headquarters are at McComb.

Britton Contracting Company, Inc., is laying 140 miles of 16-in. for the Manufacturers Light and Heat Company from Renova to Pittsburgh, Pennsylvania, and 20 miles of 24-in. between the Monongahela River and Hickory, Pennsylvania. The field office for the former spread is at Greensburg, Pennsylvania, with L. A. Stewart the superintendent. The latter spread has its headquarters at Finleyville, Pennsylvania, and Fred McKenzie is superintendent.

Cheek Construction Company, P. O. Box 491, Ulysses, Kansas, has under construction for the Cities Service Gas Company, a 101-mile gathering system in the Hugoton field. Pipe sizes are from 6 in. through 22 in.

Conyes Construction Corporation, 2884 San Pablo Avenue, San Pablo, California, is laying 117 miles of 22-in. pipe for the Ohio Oil Company between Sheridan, Indiana, and Lima, Ohio. The field office is at Elwood, Indiana, with M. A. Noorwood in charge.

Houston Contracting Company, 2707 Ferndale Place, Houston, Texas, has the following work under contract:

Approximately 181 miles of 26-in. gas line for Texas Gas Transmission Corporation from the vicinity of Bastrop, Louisiana, south to the vicinity of Eunice, Louisiana. This work is being done by three spreads as follows:

North spread starting near Beekman, Louisiana, and laying approximately 65 miles south to the vicinity of Grayson, Louisiana. W. H. Hayes, superintendent; M. L. Thompson, assistant superintendent; J. C. Strickler and J. B. Stoddard, office; headquarters, Monroe, Louisiana.

Center spread starting at header on the north side of the Red River near Pineville, Louisiana, and laying approximately 60 miles north to the vicinity of Grayson, Louisiana. E. C. Norris, superintendent; R. E. Thornton, assistant superintendent; R. J. Axsom, office; headquarters, Olla, Louisiana.

South spread starting at header on south side of the Red River and laying approximately 56 miles south to Tepetate field near Eunice, Louisiana. F. A. Silar, superintendent; C. V. Oliver, assistant superintendent; L. F. Redfearn, office; headquarters, Eunice, Louisiana.

Approximately 140 miles of 12-in, 8-in. and 6-in. lay and take up for Interstate Oil Pipe Line Company in the vicinity of New Iberia and Franklin, Louisiana. H. L. Leake, superintendent; S. B. Harrison, assistant superintendent; H. C. MacWhinnie, office; headquarters, Franklin, Louisiana.

H. B. Zachry Company, P. O. Box 2570, San Antonio 6, Texas, will complete in December 73 miles of 30-in. for Texas Eastern Transmission Corporation, extending from Lebanon, Tennessee, to Columbia. A. Vaughn is superintendent.

Additions are being made to compressor stations at Bushton, Mullinville, and Clifton, Kansas, for Northern Natural Gas Company. J. R. Johnson is general superintendent.

Comstock Midwestern, Ltd., 206 Laird Drive, Leaside, Ontario, Canada, is at work on 64 miles of pipe line for Imperial Oil, Ltd., from Sarnia to London, Canada. This is a part of the Sarnia-Toronto system, which overall will be 210 miles of 10 and 12-in. The section from London to Toronto is scheduled for construction in the spring. This is a products pipe line.

Gulf Southern Contractors, 516½ Louisiana Avenue, Shreveport, Louisiana, have the overall contract to lay approximately 1000 miles of pipe for the United Gas Pipe Line Company in Louisiana, Texas, and Mississippi. Gulf Southern is a contracting group consisting of River Construction Corporation, Fort Worth, Texas; Oklahoma Contracting Company, Dallas, Texas; J. Ray McDermott and Company, New Orleans, Louisiana, and Morrison-Knudsen Company, Inc., Boise, Idaho.

Oral Argument Scheduled

The Federal Power Commission has scheduled an oral argument to be held December 7 in Washington, D. C., in the proceedings involving the proposal by The Montana Power Company, of Butte, to import natural gas from Canada.

Reese Brothers Construction Company, Hugoton, Kansas, is constructing a gathering system for Northern Natural Gas Company in Texas County, Oklahoma; Kearny, Finney, Haskell, Seward, and Morton counties, Kansas. Overall the system will be 181 miles of 4, 6, and 8-in. pipe. Paul G. Reese and Gale Reese are superintendents, Edd Reese spreadman, and Chet Beighle office manager.

Williams Bros.-Davis Company, 6006 Jensen Drive, Houston, Texas, has under construction 165 miles of 30-in. for Texas Eastern Transmission Corporation. The section extends from Koscuisko, Mississippi, to Florence, Alabama. The field office is at Red Bay, Alabama, with G. R. Hamilton superintendent, and W. M. Clyma, office manager.

Midwestern Constructors, Inc., 105 North Boulder, Tulsa, Oklahoma, had completed approximately 75 per cent of Texas Illinois Natural Gas Pipeline Company's Mississippi River crossing the middle of November. Three 20-in. lines are being installed near Wittenburg, Missouri. The field office is at Grand Tower, Illinois. Howard S. Lipp is coordinator, Friday Davis superintendent in charge of pipe, and Ivan Steele office manager.

The contractor also is installing additional compressor units for Panhandle Eastern Pipe Line Company at Tuscola, Illinois, and Edgerton, Indiana. F. C. Snavely is superintendent and H. H. Voss office manager at Tuscola, and K. L. Kreamalmyer superintendent at Edgerton. Both jobs are about 55 per cent completed.

In Marion County, Illinois, 31,250 ft of 26-in. pipe and 21,300 ft of 24-in. are being laid for The Texas Company, the work being 20 per cent completed. John Work is superintendent and N. Boies office manager.

For Aluminum Ore Company, Bauxite, Arkansas, 8800 ft of pipe has just been completed, and 7500 ft of 16-in. Dresser-coupled line is 90 per cent completed. Additionally, there are 12,500 ft of 6-in. through 16-in. water, mud, and gas lines being laid, which are 80 per cent completed. Earl Powell is superintendent and Morris D. Garey office manager.

Sheehan Pipe Line Construction Company, 529 National Bank of Tulsa Building, Tulsa, Oklahoma, began laying 25 miles of 20-in. November 20 for the Ohio Fuel Gas Company near Xenia, Ohio. On November 5, work began on 18 miles of 8-in. between Janesville and Fort Atkinson, Wisconsin, for the Wisconsin Natural Gas Company. On the 18 miles of 16-in. near Raytown, Missouri, for Service Pipe Line Company, 8 miles had been completed to November 21.

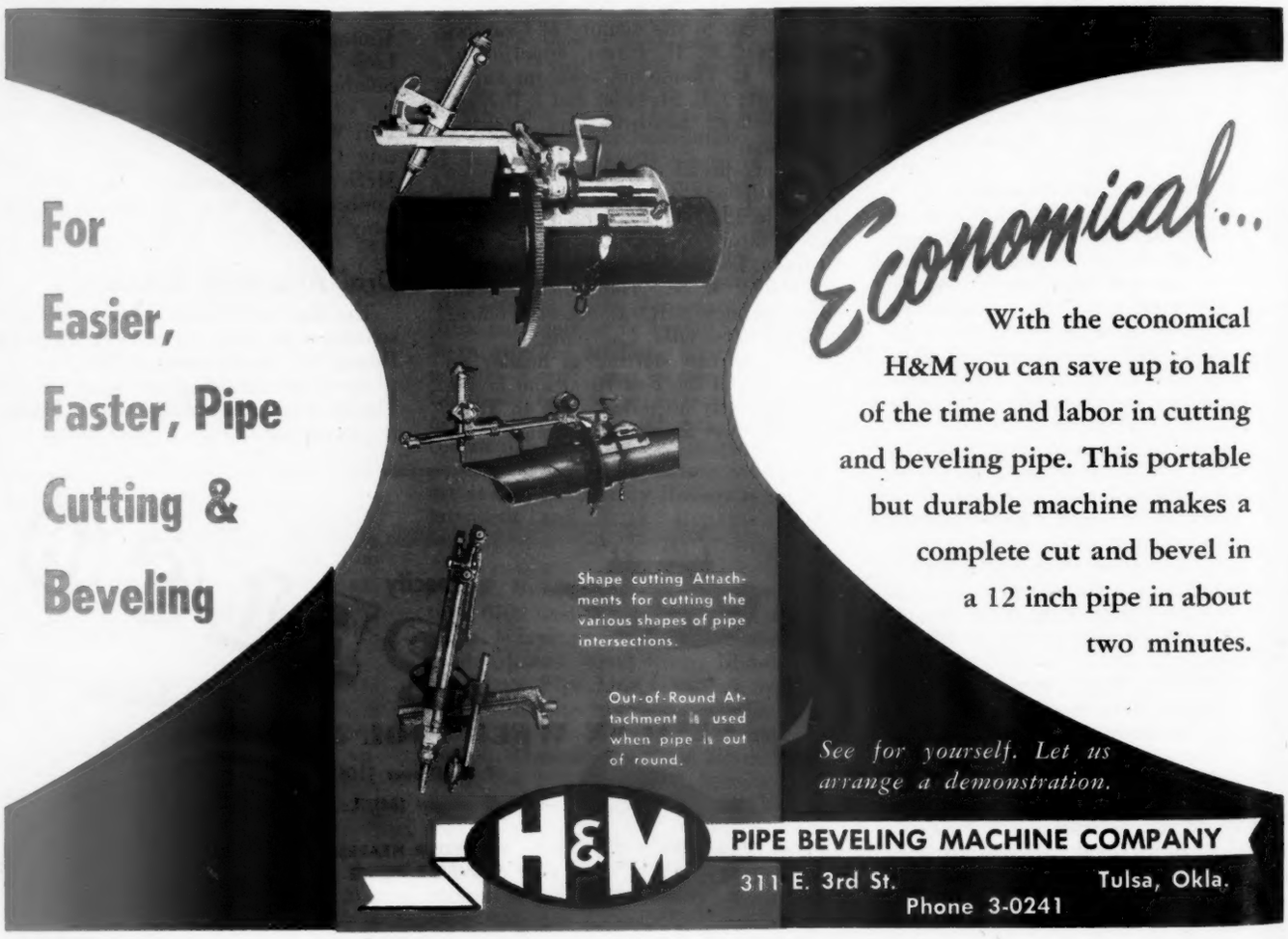
G. G. Griffis Construction Company, 2514½ East 15th Street, Tulsa, Oklahoma, is making progress on the 210 miles of 26-in. loops being laid for Northern Natural Gas Company in Kansas, Oklahoma, Texas, and Nebraska. The field office is at Great Bend, Kansas. G. L. Mims is general superintendent, E. G. Grisham spreadman, and Mont Wood office manager.

Another job being handled by this contractor is 47 miles of 12-in. loops in Kansas for Phillips Pipe Line Company. The field office for this work is at Medicine Lodge, Kansas. Joe Bishop is superintendent and Ed Rensch office manager.

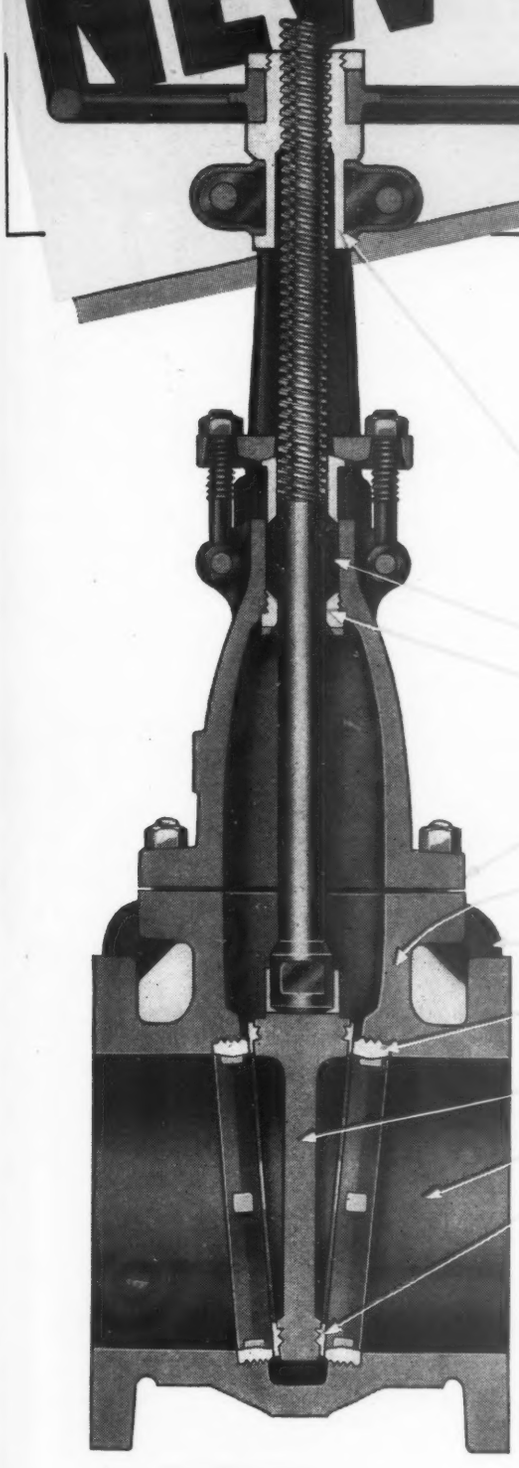
Also, a 30-mile 20-in. loop is being laid in Missouri for Service Pipe Line Company. The field headquarters are at Kirksville, Missouri, with J. E. Ellis, superintendent and Phil Whitaker office manager.

Pentzien, Inc., Omaha, Nebraska, is installing a crossing under the Ohio River near Portsmouth, Ohio, for the Texas Eastern Transmission Corporation.

Vaughn and Taylor Construction Company, Inc., P. O. Box 1351, Wichita Falls, Texas, is laying a 179-mile gathering system in the Ulysses, Kansas, area for the Cities Service Gas Company. Pipe sizes range from 4 in. through 30 in. The field office is at Ulysses. D. D. Vaughn is superintendent and C. E. Sayles office manager.


For
Easier,
Faster, Pipe
Cutting &
Beveling
Shape cutting Attachments for cutting the various shapes of pipe intersections.
Out-of-Round Attachment is used when pipe is out of round.
Economical...
With the economical H&M you can save up to half of the time and labor in cutting and beveling pipe. This portable but durable machine makes a complete cut and bevel in a 12 inch pipe in about two minutes.
See for yourself. Let us arrange a demonstration.
H&M
PIPE BEVELING MACHINE COMPANY
311 E. 3rd St. Tulsa, Okla.
Phone 3-0241

NEW . . . a completely redesigned line of IRON VALVES by OIC



NOW the workhorse of the family—OIC's iron valve—offers you features formerly found only in steel valves. It's a brand new valve built around more than a third of a century's experience in making iron valves. We kept only the old handwheel.

Examine these construction details:

1 Lubricated yoke bushing, renewable without removing bonnet.

2 Deeper stuffing box; longer packing life.

3 Inserted back seat bushing permits repacking under full pressure.

4 Stronger body-bonnet joint; uniform gasket compression.

5 Better metal distribution, reduced weight, increased strength.

6 Sturdy tie-ribs; added resistance to pipeline stresses.

7 End-seated bronze seat rings will not loosen in service.

8 I-Beam type solid wedge, accurately guided.

9 Straight-through port areas reduce flow resistance.

10 Rolled-in seat facings on wedges give longer life.

OIC's new line of Iron Valves gives you longer service, lower upkeep and greater security. For Bulletin 805 telling you all about them, call your local OIC distributor or write The Ohio Injector Company, Wadsworth, Ohio.

OIC
FOUNDED 1883

VALVES

FORGED AND CAST STEEL · IRON · BRONZE

NEWS

Scurry Field Unitization Expected to Raise Yield

Lion Oil Company engineers are predicting that the new unitization agreement for Diamond "M" field, Scurry County, Texas, will allow recovery of twice as much oil as would be otherwise obtainable.

The Railroad Commission has approved the plan unit agreement, which calls for water and gas injection. Although the joint operating plan covers but 112 wells, it is believed that it will be extended to about 1300 producing from the formation. A Lion spokesman said a 10-month test in the Diamond "M" field led the company to believe that $11,000,000 spent on water injection for the field would allow production of an extra $58,000,000 worth of oil.

Gas Companies to Handle Priority of Natural Gas

C. P. Rather, assistant deputy administration for the Petroleum Administration for Defense, has announced that the PAD has decided against a priority system for natural gas for essential industries. Rather made his announcement after the quarterly meeting of the Interior Department's Gas Industry Advisory Council. The gas industry convinced PAD that it could do a better job of averting gas shortages than that agency could, Rather reported.

Rather added that gas companies that find they cannot handle the problem could get help from PAD and if necessary a directive covering the specific situation could be issued.

Tidelands Case Rests

The controversial tidelands bill has been set aside until Congress convenes next month. Meanwhile, in Texas, Senator Lyndon B. Johnson has written President Truman urging him not to allow the government to assert its claim to the coastal submerged lands before congress determines their ownership. He added that "persistent reports" had come to him that the Interior Department will issue federal leases without foundation.

NPC Reports Prices Up on Oil From Coal Process

The National Petroleum Council has reported that a five months' study has shown that production of gasoline from coal would cost 43½ cents a gallon, not counting distributing and marketing expense, compared with a cost of 12 to 13 cents a gallon on gasoline produced from crude oil. The council added that gasoline from oil shale would cost 14.7 cents per gallon.

The U. S. Bureau of Mines challenged the council's figures on the coal process, giving as an example their pilot plant at Louisiana, Missouri, where, they stated, has been shown that gasoline can be made from coal in competition with gasoline refined from crude. Bureau officials also said the council failed to take into consideration income from sale of by-products such as phenol, benzene, toluene, naphthalene ammonia, sulfur.

The council had been asked to approve the proposal of a private company that is seeking government authority to build a $400,000,000 plant for converting coal to liquid fuel. The council stated, "Study of this proposal is not within the scope of the committee's assignment. Attention is directed, however, to the fact that the disadvantages of high investment cost involved in the basic coal hydrogenation step will still be present and that additional investment will be required for the further processing, recovery, and purification, of the chemicals. We are advised that such chemicals can be produced from petroleum at much lower cost."

Officers and guests at the recent meeting of the Los Angeles Basin chapter of the American Petroleum Institute. Standing are C. C. Gandaubert, chairman, and Strafford Park, vice chairman. Sitting, Jack Porter, technical advisor, Empresa Nacional Del Petroleo, Chilean Government; H. Wayne Hoylman, geophysical consultant and featured speaker, who discussed air borne magnatometer, and D. W. Campbell, manager, Long Beach Chamber at Commerce.

Texas Oil Output Lowered For Second Straight Month

For the second straight month, Texas lowered its output of crude oil this month. Daily crude oil production allowables in this state are down 3,000,000 bbl as a result of the cut made by the Texas Railroad Commission. Permissible crude output for this month is 2,924,918 bbl daily, a reduction of 75,519 bbl daily from the November 10 allowable.

Producing schedule remains the same basis, 23 days for the state generally and 19 for East Texas, but due to the extra day in December, a lower average daily production will result.

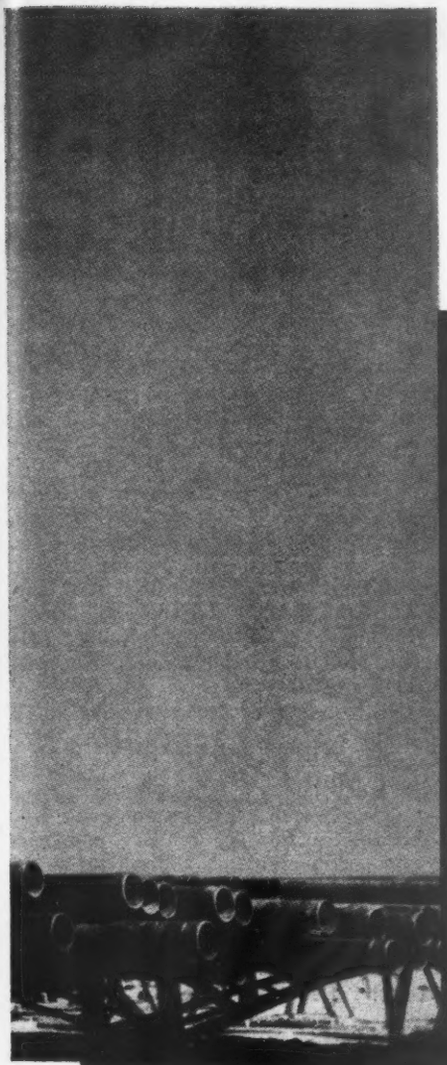
Steel Allotments Are Cut For First Period of 1952

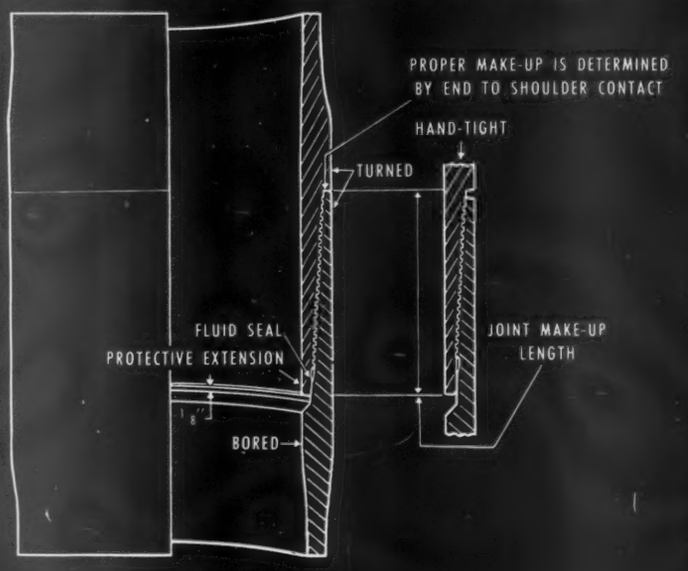
A total of 2881 applications for steel were received by the Petroleum Administration for Defense for the first quarter of 1952, but 1026 were turned down, Secretary of Interior Oscar Chapman has reported. Chapman added that PAD was allotted 466,000 tons of casing and tubing by the Defense Production Administration for distribution to the oil and gas industry during the first quarter. Of this, 409,250 tons were made available for domestic operations.

Chapman added that about one-third of the applications denied were defective, although others were rejected because the applicants did not qualify for primary allotments. Those who did not qualify are permitted to file new applications for supplemental allotments within two weeks after receipt of the denial.

Oklahoma Unitization Law Upheld by High Court

The Supreme Court has upheld unitization of Oklahoma's oil fields, the second time it has approved a judgment of the Corporation Commission in the Chitwood gas field. Claude C. Spiers, who owns a quarter section land near the Chitwood field in Grady County, filed the case. Magnolia Petroleum Company submitted evidence to the commission sufficient to justify unitization, the court ruled. Magnolia leases 99.02 per cent of the area in the field, and lessees other than Spiers approved unitization.





Spang Extreme Line Casing has a minimum OD joint, provides maximum running speeds and eliminates separate couplings, while retaining maximum joint strength.

Spang Extreme Line Casing's streamlined exterior avoids hanging-up while running, and the smooth interior allows tools to pass readily.

Spang Extreme Line Casing is engineered for dependable performance in the particularly rugged demands existing in deep well drilling.

Eight reasons why it pays to use Spang Extreme Line Casing are detailed in Bulletin 352. Write for your copy, or check for details at your National Supply Store.

THE NATIONAL SUPPLY COMPANY

Spang-Chalfant Division—General Sales Offices: Pittsburgh, Pa.

Division Tubular Offices:

DENVER, COLORADO • HOUSTON, TEXAS • FORT WORTH, TEXAS • LOS ANGELES, CALIFORNIA
PITTSBURGH, PENNSYLVANIA • TULSA, OKLAHOMA • CALGARY, ALBERTA, CANADA

NATIONAL BLUE PRODUCTS

SUPERIOR & ATLAS ENGINES

Oil Industry Third Quarter Sales and Net Incomes Top 1950 Reports for Same Period

Seventeen oil companies reported aggregate net incomes of $386,954,226 for the third quarter of 1951, an 8 per cent increase over the second quarter and 14.3 per cent over the comparable 1950 quarter. Most companies reported that earnings at the end of the first nine months of the year, September 30, showed a considerable increase over the same period last year.

The majority of the companies reported a more extensive oil search program and an expansion of facilities.

Figures from some of the leading companies are as follows:

Atlantic Refining. At the end of the nine months' period, Atlantic reported a net income of $31,987,761 compared to $27,809,230 for the same period last year. Gross income amounted to $409,402,294 compared to $342,679,387 the first nine months last year.

Bishop Oil. Net profit for the first nine months of 1951 amounted to $216,758.30 as compared to $114,216.16 during the first nine months of last year. Gross income was $1,393,282.10 compared to $990,413.55 during the first nine months of 1950.

Continental Oil. Net income for the third quarter ending September 30 was $9,271,000 under the $12,556,000 reported for the third quarter last year. For the first nine months ending on the same date, however, net profits amounted to $31,304,000, more than the $29,660,000 reported for a comparable period in 1950.

Deep Rock Oil. Preliminary net income for the first nine months was reported as $1,797,000, compared with $2,033,000 for the same period of 1950, one of the few companies reporting lower net profits.

Derby Oil. Net income at the end of the year's first nine months amounted to $998,280.97, compared with $806,862.23 last year, or a percentage increase of 23.72 per cent. Crude oil production totaled 891,399 compared to 814,817 last year.

Hancock Oil. This company reported third quarter net incomes under that of the same period of 1950. Third quarter this year saw a net profit of $434,297.20, compared with $620,926.90.

Houston Oil Company of Texas. At the end of 1951's first nine months, Houston oil reported net profits totaling $5,275,407, compared to $4,355,372 last year. Crude oil production rose from 11,592 bbl during that period in 1950 compared with 13,822 bbl during 1951.

Lion Oil. In its report for the first nine months of 1951, Lion Oil showed net income totaling $13,902,320 in the latest period as against $14,861,400 for the comparable nine months of 1950.

Maracaibo Oil Exploration. At the end of the first half of the fiscal year, six months, this company reports a net income of $391,529, which included $298,645 profit from sale of Gulf Plains Corporation Stock, less about $75,000 to cover estimated Federal income tax thereon. A total of $167,884 was reported less sale of aforementioned stock.

Ohio Oil. Ohio's net income for the first nine months of 1951 amounted to $30,950,402 compared to $28,225,031 for the same period last year. It produced 25,118,000 bbl of oil, compared with 21,822,000 last year.

Panhandle Producing and Refining. A total of $348,529.02 was reported for the net income at the end of the third quarter for Panhandle, and a total of $1,023,539.85 for the nine months ended September 30, 1951.

Phillips Petroleum Company. Net profit for the third quarter of 1951 amounted to $17,749,065. For the first nine months of 1951, net profit was $49,751,662, compared with $35,885,522.

Richfield Oil. Richfield reported net income for the first nine months of this year of $21,214,503, more than the $15,788,531 reported during 1950.

Seaboard Oil. Net income at the end of the nine-month period amounted to $1,412,105, compared to $3,774,694 reported last year.

Shell Oil. A total of $22,541,251 was reported for the third quarter, and $67,736,482 for the first nine months as against $52,700,268 in 1950.

Socony-Vacuum Oil. Net earnings for the first nine months this year totaled $119,000,000, compared with $85,000,000 in the same period of 1950. Net production averaged 210,000 bbl compared with 174,000 in 1950.

Skelly Oil Company. Skelly reported net income totaling $22,036,961 for the nine months ended September 30, as compared with $19,954,254 in 1950.

Standard Oil (Indiana). This company reported a total of $105,404,000 for the first nine months of 1951, considerably above the $87,334,000 received for the same period of 1950.

The Texas Company. Texaco and its subsidiaries reported net income of $132,063,133 at the end of the nine-month period, a considerable amount more than the $95,133,143 reported in the same period of 1950.

Tide Water Company. At the end of the first nine months, Tide Water reported a net income of $26,771,472 compared with $23,455,627 earned during the same period in 1950.

Texas Pacific Coal and Oil. On September 30, this company reported nine months' net earnings of $5,068,296 compared with $4,334,668 reported last year.

Lebanon to Seek Tighter Control on Oil Industry

From Beirut, Lebanon, comes word that that country wants a bigger hand in the business of running American and British-owned oil facilities within its boundaries. The chamber of deputies has accused the American-owned Trans-Arabian Pipeline Company of smuggling oil to Israel and refusing to hire a promised quota of Lebanese.

April World Oil Statistics

During April, world production of crude petroleum increased to 11,673,000 bbl daily, a gain of 170,000 bbl over the March daily rate, according to the U. S. Bureau of Mines report. The principal increases in daily average production were: Kuwait, 126,000 bbl; United States, 75,000; Saudi Arabia, 56,000; Venezuela, 11,000; and the U. S. S. R. an estimated 25,000 bbl. Due to strikes at the oil fields, and at the Abadan refinery, crude oil production in Iran decreased 135,000 bbl daily in April. Kuwait produced a record quantity of crude in April, as did Saudi Arabia, and in the United States, daily average crude production was a new high.

Western Europe's imports of crude petroleum exceeded 1,000,000 bbl daily in April. The major importing countries were, in barrels daily: France, 369,000 (March 306,000); United Kingdom, 259,000 (258,000); Italy and Trieste, 150,000 (119,000); Netherlands, 104,000 (129,000); and Western Germany 75,000 (77,000).

ECA Brings European Oil Men to U.S.

Twenty-nine experts from seven free nations of Europe—refinery managers and engineers, and manufacturers of drilling and refining equipment—arrived recently in New York for an intensive six-week study of the modern equipment and methods used by American oil companies.

The study is being sponsored by the Economic Cooperation Administration under its technical assistance program, with ECA and the European countries sharing the costs.

The European experts will be divided into two groups, one studying petroleum refinery processes and equipment, the other concentrating on production methods and drilling equipment. The 21-man refinery group's study will take them to the New York-New Jersey area, Philadelphia, Louisiana, Texas, Chicago, Milwaukee and Buffalo.

Meanwhile, the other group of eight experts will be studying crude oil drilling equipment and crude oil production methods. They will visit equipment manufacturers and see oil operations in various sections of the country.

Socony Employees Win Cash for Suggestions

Approximately one in every four employees of Socony-Vacuum Oil Company, Inc., who turned in suggestions for improving company operations since the start of a new suggestion system over three years ago has received a cash award, it was reported by the company's suggestion system committee. From the inception of the system in February, 1948, through September, this year, 17,082 suggestions were received from 25,000 employees throughout the country, the committee said. During that period $97,000 has been paid winners.

Pacific Sections of Exploration Organizations Elect 1952 Officers

AAPG Pacific Coast Section Officers. Elected at the 28th annual meeting of the American Association of Petroleum Geologists, Society of Exploration Geophysicists, and Society of Economic Paleonologists in Los Angeles were: Secretary and treasurer, Rufus M. Smith, geologist, Continental Oil Company; president, Homer J. Steiny, geologist, Tidewater Associated Oil, and vice president, Harold Sullwold, Jr., geologist and petroleum engineer, William Ross Caheen and Associates.

Congratulating the President. R. W. White offers best wishes to Homer J. Steiny on his election as president of the AAPG, Pacific Coast section.

SEPM Officers. The Society of Economic Paleontologists and Minerologists, Pacific Coast section, elected W. T. Rothwell, division paleontologist, Richfield, president, and James L. Crowell, paleontologist, Shell, secretary-treasurer.

Four SEG Officers. Named to head the Pacific Coast section of the Society of Exploration Geophysicists for 1952 were: Secretary-treasurer, M. Sklar, geophysicist, Union Oil Company; vice president, northern district, Robert B. Galeski, geologist, Honolulu Oil Corporation; president, W. L. Matjasic, district geologist, Honolulu Oil, and vice president, southern district, D. H. Scott, geophysical supervisor, The Texas Company.

U. S. Wants to Raise Oil by 1,000,000-Bbl Daily

The government's proposal to make available an additional million barrels of oil a day would cost the petroleum industry well over $1 billion and about 3,231,000 tons of steel, according to a special committee set up by the National Petroleum Council. The NPC report pointed out that in making the estimate it was not recommending the government program nor even "indicating that the proposed increments are the most economical or desirable ones."

The government's program involved additional storage and transportation facilities for 500,000 bbl daily of existing producing and refining capacity, and new production facilities of 300,000 bbl a day in the U. S., 100,000 bbl a day in Canada; 100,000 in Vanezuela.

The committee stated that the 1,383,000 tons of steel needed to carry out the program would involve practically all in the U. S. program.

The committee pointed out that "a major part of the indicated amount of expansion has already taken place."

OPS Raises Ceiling Prices On Petroleum Products

Increases in ceiling prices for kerosine, distillate type burning oils, and diesel fuel, ranging from three-tenths to one-half cent per gallon at the tank wagon level in a group of midwestern states, were authorized recently by the Office of Price Stabilization.

In a supplementary regulation (SR 3 to CPR 17, effective October 30, 1951), OPS provides that the tank wagon ceiling price of a seller of these products may be adjusted to a price no higher than the selling price on December 13, 1950, or the nearest prior date that a sale was made, plus the following:

(1) One-half cent per gallon in Wisconsin, Minnesota, North Dakota, South Dakota, Iowa, and Kansas.

(2) Three-tenths of a cent per gallon in Arkansas, Indiana, Missouri, Nebraska, Michigan, and Illinois (except in the Metropolitan Chicago area).

OPS pointed out that many of the distributors involved had observed the voluntary price freeze requested by the Director of Price Stabilization on December 18, 1950.

PERSONALS

Howard C. Pyle, well known California oil consultant was elected president of the Jergins Oil Company and coincidentally named a director, according to a statement just issued by Lowell Stanley, newly elected chairman of the board.

Pyle was for some years chief production engineer for Union Oil Company of California, later became vice president of the Bank of America in Los Angeles in charge of oil negotiations, more recently still was president of the Continental Consolidated Corporation, and is a widely experienced geologist and petroleum engineer.

Lowell Stanley, one of the founders of the company and an officer since its organization in 1938, was elected chairman of the board in succession to the late C. M. Cotton.

W. C. Wenzel, executive manager of the Pennsylvania Grade Crude Oil Association, Oil City, Pennsylvania, left New York City recently by plane for London on a several weeks' tour of Europe. He will visit association members and survey conditions of Pennsylvania oils.

Lee N. Haugen, manager of the refining division of Cities Service Oil Company (Delaware), has been named a vice president. Two other vice presidents were also appointed, making three vice presidencies created in with the company's expansion of facilities and activities. They are: **Frank M. Perry,** manager of the gasoline-chemical division, and **Gentry Lee,** general counsel.

Direction of the oil production and the land and geological divisions will be vested in vice president **Robert L. Kidd,** with **Ray Althouse** as assistant. Kidd also becomes president of Cities Production Corporation, a wholly owned subsidiary of Cities Service Oil Company which owns gasoline plants and some 10,000 bbl per day of crude production.

C. S. Mitchell was elected president of Cities Service Pipe Line Company, which handles crude oil and products pipe line operations.

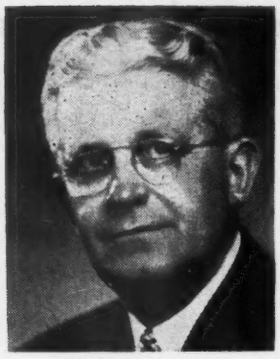
Sam Harlan, vice president, was elected president of American Gas Production Corporation, another wholly owned subsidiary, which produces about 250,000,000 cu ft of gas per day.

T. P. Steeper, vice president, was elected president of Terminal Facilities, Inc., which owns compounding facilities and some 900 tank cars.

Named to the operating committee were Harlan, Haugen, Kidd, **Lloyd Lynd, F. B. Plank, E. L. Stauffacher,** Steeper, and Lee.

President Ambrose said the new series of moves "spreads responsibilities around among a group of top executives of the company and puts the organization in better position to carry forward its planned program of expanded activities with expedition and efficiency."

W. K. Whiteford



M. S. Beringer

J. Y. Murdoch

Milton S. Beringer has been elected chairman of the board of The British American Oil Company Limited. He succeeds **William K. Whiteford** who has been elected an executive vice president and director of the Gulf Oil Corporation. Beringer, who joined British American 18 years ago, has been vice president of manufacturing for the past six years and was appointed a director of the company in 1950. He is also a vice president and director of B. A.-Shawinigan Limited, a petrochemical company formed to manufacture acetone and phenol.

At the same board meeting **James Y. Murdoch** was elected chairman of the executive committee of the board of British American. Murdoch has served as a director of B-A for 18 years, and is president of several large companies including Noranda Mines Limited.

Thomas Bradford Drew, head of the department of chemical engineering at Columbia University, New York, delivered the third annual lecture of the American Institute of Chemical Engineers. The lecture, a technical event of some importance to the nation's chemical engineers, reviewed critically progress in some phase of chemical engineering.

Professor Drew spoke at the Institute's annual meeting in Atlantic City. His talk covered diffusion, a phenomena with which he has had long familiarity; it is important in distillation, drying, and other chemical operations.

He holds a B.S. and a M.S. from Massachusetts Institute of Technology.

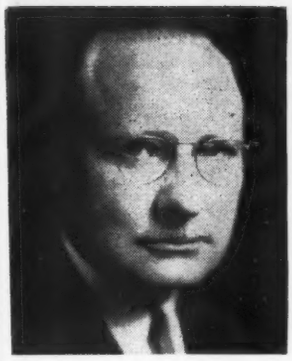
E. F. Battson, Houston, administrative vice president of Continental Oil Company, has been elected a director of the company at a meeting of the board of directors in New York City. At the same meeting **W. C. MacMillan,** Houston, senior vice president, resigned as a director, expressing the wish to restrict his activities due to ill health. He became vice president and regional general manager at Denver in February, 1949, and early this year was appointed administrative vice president, Houston.

MacMillan attended Brown University, and joined Continental in geological work in 1928. He rose through exploration and production assignments, being elected vice president in charge of production in 1943.

Clarence B. Round, was promoted to the newly created position of assistant to Harold G. Osborn, vice president in charge of manufacturing for Continental Oil Company. He will make his headquarters in Ponca City.

To succeed Round as coordinator of manufacturing operations at Ponca City, the company appointed **I. A. Harrisberger,** who has been chief manufacturing clerk since 1937.

Guests at the Nomads' meeting, Los Angeles chapter, recently were: Front row, Roy K. Haug, Aram Company; Mike H. Bush, Southeastern de Mexico; William W. Stevenson, Mene Grande Oil, and Jack Fisher, Esso Colombiano. Back row, A. J. Armell, Componhia dos Petrolo de Portugal; J. W. Clampett, Iraq Petroleum Company; Major M. F. Wojcik, U.S.M.C., speaker of the evening; General W. A. Worton, U.S.M.C. (retired) Fred Pevito, and Harvey Stein, Texas Petroleum Company.



F. C. Sealey

E. M. Butterworth

C. H. Jennings

F. C. Sealey and **E. M. Butterworth** have been elected vice presidents of California Texas Oil Company, Limited. Sealey had been associated with the oil industry during his entire business career which began with The Texas Company in 1917 as an assistant geologist. The past 13 years have been devoted to petroleum producing activities abroad, and since 1949, he has been in charge of producing and exploration for the Caltex-Bahrein group of companies, with headquarters in New York.

Butterworth, who is a geologist by training, began his oil business career after graduation from the University of California in 1916. He was for a considerable period active in the East Indies, beginning in 1924, when he conducted a group of exploration men in that area. Butterworth has been directly concerned with Government relations in Sumatra and New Guinea for the past several years for the Caltex-Bahrein Group.

H. F. Glair, who has been general manager of manufacturing since 1933 and a director since 1934, Standard Oil Company (Indiana), is appointed to a new position as director of purchases.

S. A. Montgomery advances to general manager of manufacturing. Assistant general manager since 1946, Montgomery was elected to the board recently.

W. J. McGill, who has been superintendent of operations since 1948, becomes assistant general manager.

On January 1, 1952, **Dr. R. C. Gunness** will also be made an assistant general manager, manufacturing department. Dr. Gunness is now manager of the company's research department. He is on leave serving as vice chairman of the research and development board of the Department of Defense in Washington.

Glair began his career with Standard Oil as a clerk at its Whiting, Indiana, refinery in 1906. He became manager of the refinery in 1929. He is responsible for patents covering improvements in the removal of wax from oil as well as novel improvements in the manufacture of candles. Montgomery joined Standard in 1919 as a chemist at its Wood River refinery. McGill went to work for Standard in 1924 as a chemist, and became manager, Wood River Refinery in 1942. Gunness joined Standard in 1938.

Charles H. Jennings, engineering manager, welding department, Westinghouse Electric Corporation, has been named president for 1951-52 of the American Welding Society. He took office during the annual meeting of the Society held in Detroit, Michigan, recently. Jennings is a graduate of Iowa State College, and in 1928 was admitted to the graduate student course of the Westinghouse Electric Corporation.

J. U. Durham, principal surveyor, American Bureau of Shipping has been elected vice president, Southern district, of the Welding Society. A graduate of the University of Michigan, Durham joined American Bureau of Shipping in 1937 and became principal surveyor in 1938.

T. B. Jefferson, editor of the *Welding Engineer* and the *Welding Encyclopedia,* McGraw-Hill publications, has been elected vice president of the Mid-Western district of the Society. A graduate of the University of Kansas, Jefferson joined McGraw-Hill in 1940.

E. N. Adams, district engineer, American Institute of Steel Construction, was named vice president of the New York and New England district. Adams is a graduate of the Worcester Polytechnic Institute.

Robert S. Green, associate professor and chairman of the department of welding engineering at Ohio State University has been elected a director of the American Welding Society. Green is a graduate of Purdue University. Directors-at-large are **E. O. Williams,** vice president, Victor Equipment Company, and **M. S. Shane,** manager of technical studies department, Cleveland Electric Illuminating Company. Williams is a graduate of the University of Southern California and has been with Victor since 1930. Shane studied at the Case School of Applied Science and Carnegie Institute of Technology. He has been with Cleveland Electric since 1940.

Eric R. Seabloom, supervisor of field engineering, Crane Company, has been named 2nd vice president of the Society. He attended the Illinois Institute of Technology, and joined the Crane Company in 1917.

Alexei P. Maradudin, metallurgist and materials engineer, Standard Oil Company of California, has been named vice president, Western district, of the society. He came to America from Russia in 1923 and entered the University of Redlands.

W. H. Bruckner, research associate professor of metallurgical engineering, University of Illinois, has received the 1951 Lincoln Gold Medal Award at the American Welding Society's annual meeting at the Hotel Book-Cadillac, Detroit, Michigan. This award is made annually to the author of the paper judged to be the greatest contribution to the advancement and use of welding for the year.

W. L. Roberts, research engineer, Westinghouse Electric Corporation, won the $750 award for the best paper from an industrial source. Others receiving awards were: **D. H. Fleig** and **C. S. Seltzer.**

For the best papers from a university source, **Dr. Ernest F. Nippes** and **John N. Ramsey** won first prizes. **William H. Colbert** received the undergraduate award.

Ellis F. Oatman has been appointed office manager of the Jacksonville, Florida, district of Sun Oil Company. Mr. Oatman formerly was office manager of the Boston, Massachusetts, district. Joining Sun Oil at the company's general offices in Philadelphia in 1930, he worked as an auditor until he was named office manager of the Providence, Rhode Island, marketing district.

Classified Ads

WANTED

Advertising man with oil field experience, 30-40 years of age, to handle advertising for large oil tool manufacturer. Headquarters will be in Los Angeles. Write Box 130, c/o The Petroleum Engineer, P. O. Box 1589, Dallas, Texas.

British Engineering Company with considerable works facilities doing large business in vessels, pipes and fittings with oil, chemical and steam industries, would be interested in a manufacturing or selling association with American firm. Write Box 131, c/o The Petroleum Engineer, P. O. Box 1589, Dallas, Texas.

NEW Williston Basin Map—Montana, Wyoming, North and South Dakota, North Nebraska, Western Iowa and Minnesota—15 miles to 1 inch—showing all townships and ranges—all wildcat activity in each state—size 42" x 48"—price, paper $10.00, cloth $17.50—address all orders and make checks payable to A. D. Austin Company, Commercial Standard Building, Fort Worth 2, Texas.

NEW SURPLUS PRESSURE GAUGES AND THERMOMETERS

Write for catalog describing thousands of surplus Pressure Gauges and Thermometers at a fraction of original cost. Available for immediate delivery.

MIKE A. TRAVIS
PHONE 5-6608
221 West Second Tulsa, Oklahoma

AC-ME MEASUREMENT ACCURATE PRECISION INSTRUMENTS TRADE MARK REG. U.S. PAT. OFF.

Home of
R. S. and Ac-Me Specialties

We are happy to announce the Re-Opening of our Houston, Texas Branch

To better serve an important oil and gas area—we are Re-Opening our Houston, Texas, Branch. This will mean faster and more efficient service for companies operating in that area. You can depend on the same quality products that have made Refinery Supply Company outstanding in the petroleum industry. Our R. S. Oil & Gas Testing Specialties PLUS our exclusive distributorship of Central Scientific Company Products have made us leaders in our field . . . and now you can look forward to an even better service . . . . . .

Remember—the Houston address is 2215 McKinney Avenue—Phone Preston 8921 . . . .

CENTRAL SCIENTIFIC COMPANY
CHICAGO

SERVICE ACCURACY R.S.C. TULSA OKLA.

REFINERY SUPPLY COMPANY

CENCO

Laboratory Apparatus and Supplies *Oil and Gas Testing Equipment*

621-23 E. 4th St. Tulsa 3, Oklahoma

BIBLIOGRAPHY—Classified list of important papers for 1950 - 1951

Natural Gas Processing and Cycling

Activities of Joint AGA—ASME Committee on Orifice Meter Test Work at Rockville, Maryland, E. E. Stovall, SGA, Annual Convention, Biloxi, Miss., April 23-25, 1951.

American Gas Association Production and Transmission Research, J. W. Ferguson, Sixth Annual Short Course in Gas Technology, sponsored by SGA, Texas College of Arts and Industries, Kingsville, Tex., May 30—June 1, 1951.

Balanced Valve Pressure Regulators: Their Selection and Capacity, Allen D. MacLean, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Calculation of Meter Charts, C. C. Cooper, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Dehydration of Gas at Well Head, Laurance S. Reid, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Determination and Application of Supercompressibility Factors, Gordon B. Gudger, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Determination of Gasoline Content of Natural Gas, J. A. Schultz, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Determination of Leakage and Unaccounted-for Gas in Distribution Systems, E. M. Harris, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Determination of Water Vapor in Natural Gas, James H. Kelly, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Dynamic Accuracy in Gas Temperature Measurement Otis F. Hunter, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Elements of Gas Contracts, V. M. Plummer, Southwestern Gas Measurement Short Course, College of Engineering The University of Oklahoma, Norman, Okla., April 10-12, 1951.

European Refining and Middle East Oil, Gustav Egloff, NPA, Annual Meeting, Hotel Traymore, Atlantic City, N. J., Sept. 12-14, 1951.

Field Measurement of Extremely High Pressures, E. P. Prater, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Field Processing-Plant Construction—Daily Input Capacity of New Plants Will Exceed Billion and a Half Cubic Feet, R. B. Tuttle, Oil and Gas J. 50, 12, 224-225, July 26, 1951.

Field Testing and Maintenance of Large Capacity Displacement Meters, Oscar C. Grubbs, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Flow-Metering Practices, C. D. Walker, Oil and Gas J. 50, 8, 80, June 28, 1951.

Fundamental Principle of Orifice Meters, E. R. Gilmore, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Fundamental Principles of Regulators, Robert Lisk, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Gas Dehydration, L. L. Laurence, ASME, Annual Petr. Mechan. Engr. Conference, Mayo Hotel, Tulsa, Okla., Sept. 24-26, 1951.

Gas Gathering System Regulators, Ross B. Baze, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Gas Laws and Their Use in Measurement, E. F. Dawson, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Gas Regulation at Extremely High Pressures, E. S. Plank, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Gas Sample Analysis, R. L. Huntington, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

General Corrosion Practices and Economics, W. A. Broome, SGA, Annual Convention, Biloxi, Miss., April 23-25, 1951.

Governmental Regulations in Industry, Scott Hughes, SGA, Annual Convention, Biloxi, Miss., April 23-25, 1951.

Gravity Balance and Gravitometer, A. W. Chandler, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Here's How Pure Oil Company Planned Its Corrosion-Prevention Program for TCC Gas Plant at its Smiths Bluff Refinery, C. A. Murray and M. A. Furth, Oil and Gas J. 50, 3, 112, 115, 116, 118, 120, 122, May 24, 1951.

High Pressure Free Fluid Knockouts, Louis R. Records and Dwight Seely, Jr., SGA, Annual Convention, Biloxi, Miss., April 23-25, 1951.

High Pressure Pilot Operated Regulators, Lyle E. Eige, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

High Pressure Regulators, J. E. Gesner, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Instrumentation Applications in the Gas Industry, D. M. Hill, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

High Pressure Free Fluid Knockouts, Louis R. Records and Dwight Seely, Jr., SGA, Annual Convention, Biloxi, Miss., April 23-25, 1951.

High Pressure Pilot Operated Regulators, Lyle E. Eige, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

High Pressure Regulators, J. E. Gesner, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Instrumentation Applications in the Gas Industry, D. M. Hill, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Large Capacity Displacement Meters, J. H. Walters, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Latest in Hypersorbers, Chem. Engr. 58, 7, 183-184, July, 1951.

Lion Chemical Produces 1200 Tons Daily of Petrochemicals From Natural Gas, F. Lawrence Resen, Oil and Gas J. 50, 10, 76-79, July 12, 1951.

Low Pressure Regulators, J. E. Gesner, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Methods of Determining the Specific Gravity of Gas, W. F. Hoag, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Natural Gas in Relation to National Defense, Paul Kayser, AGA, Spring Meeting, Baker Hotel, Dallas, Tex., May 7-8, 1951.

Newest Gas Processing Plant, David P. Thornton, Jr., Petr. Processing 6, 7, 736-739, July, 1951.

Observations and Problems in Recovery and Retention of Light Hydrocarbons, A. M. L. Kube, Oil and Gas J. 49, 41, 98-100, 103-104, 107-108, 117, Feb. 15, 1951.

Operation and Maintenance of Orifice Meters, H. W. Gillian, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Operation of a Direct Connected Engine Driven Compressor as a Gas Generator, J. N. MacKendrick, George Bollman, and C. A. Chamberlain, ASME, Annual Conference and Exhibit, Baker Hotel, Dallas, Tex., June 25-29, 1951.

Orifice Meters, J. L. Cottrell, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Orifice Meters, L. K. Spinks, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Orifice Meters, D. C. Wiley, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Our Research Program, E. F. Schmidt, AGA, Spring Meeting, Baker Hotel, Dallas, Tex., May 7-8, 1951.

Panoma Plant Achieves Low Maintenance-Operation Costs, Part II—Auxiliary Equipment, I. Earl Nutter and C. D. Van Vliet, Petr. Refiner 30, 5, 98-102, May, 1951.

Prevention of Freezing in Measuring and Regulating Equipment, R. F. Downey, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Preventive Maintenance for the Miles Ahead, Aubrey L. Randall, SGA, Annual Convention, Biloxi, Miss., April 23-25, 1951.

Principles of Automatic Control, Win Rochelle, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Problems in Measurement of Natural Gas Containing Hydrogen Sulphide, Terrell Hamaker, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Production of Aromatics from Natural Gas Liquids, C. R. Williams and R. E. Sutherland, Oil and Gas J. 50, 14, 84, 88, 101, Aug. 9, 1951.

Recent Legislation Affecting Gas Measurement, Charles A. Breitung, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Recording Instruments, E. T. Oettinger, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Remote Recording and Control, W. E. Rufleth, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Removal of Liquids from Natural Gas Before Entering Pipe Lines, J. H. Echterhoff, SGA, Annual Convention, Biloxi, Miss., April 23-25, 1951.

Removal of Water from Natural Gas, E. L. McCarthy, Sixth Annual Short Course in Gas Technology, sponsored by SGA, Texas College of Arts and Industries, Kingsville, Tex., May 30-June 1, 1951.

Safe Practices in Gas Measurement and Regulation, D. A. Klemme, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Safety Depends Upon Men Who Carry Its Banner, H. W. Boggess, NGAA, Permian Basin Regional Meeting, Big Spring, Tex., Feb., 23, 1951.

Some Operating Aspects of Gas Storage Accounting, A. A. Cullman, AGA, Spring Meeting, Baker Hotel, Dallas, Tex., May 7-8, 1951.

Steam-Powered Compressor Station, Donald M. Taylor, World Oil 133, 3, 231-233, Aug., 1951.

Subsurface Storage of LP Gas as a Liquid, William H. Justice, Sixth Annual Short Course in Gas Technology, sponsored by SGA, Texas College of Arts and Industries Kingsville, Tex., May 30-June 1, 1951.

Telemetering, Remote Control and Supervisory Systems, E. D. Nuttall, SGA, Annual Convention, Biloxi, Miss., April 23-25, 1951.

The Use of Pressure and Temperature Transmitters in Gas Measurement, G. F. Bright, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

Utilization

Catalytic Effect of Several Metals on the Oxidation of Lubricating Oils, D. W. Sawyer, ASME, Semi-Annual Meeting, Toronto, Ontario, Canada, June 11-15, 1951.

Design of Exhaust Snubber for The Gas Engine, R. L. Leadbetter, ASME, Annual Conference and Exhibit, Baker Hotel, Dallas, Tex., June 25-29, 1951.

Fuel Preparation, D. E. White, ASME, Annual Conference and Exhibit, Baker Hotel, Dallas, Tex., June 25-29, 1951.

Gas Turbine Generating Units, M. E. Orelup, SGA, Annual Convention, Biloxi, Miss., April 23-25, 1951.

Methods for Improving Gasoline Antiknock Quality, Martin L. Alspaugh, WPRA, Regional Meeting, Broadview Hotel, Wichita, Kansas, July 19-20, 1951.

Modern Instrumentation Aids Economy in the Carbon Black Industry, J. M. Ribble, ASME, Annual Petr. Mechan. Engr. Conference, Mayo Hotel, Tulsa, Okla., Sept. 24-26, 1951.

Nordberg Supairthermal Diesel, Duafuel and Gas Engines Operating on the Miller Supercharging System, Ralph H. Miller, ASME, Annual Petr. Mechan. Engr. Conference, Mayo Hotel, Tulsa, Okla., Sept. 24-26, 1951.

Petroleum-Chemicals Reviewed, R. F. Goldstein, The Petr. Times LV, 1401, 282-283, April 20, 1951.

Plastics From Acetylene on Increase May Lead to Its Manufacture from Natural Gas, R. S. Aries and R. M. Criner, Oil and Gas J. 50, 2, 122, 125, 126, May 17, 1951.

Possible Mechanisms by Which Combustion Chamber Deposits Accumulate and Influence Knock, L. F. Dumont, SAE, Summer Meeting, French Lick Springs, Hotel, French Lick, Ind., June 3-8, 1951.

Selection of Oils for High Btu Gas Production, H. R. Linden and E. S. Pettyjohn, Am. Gas Assn. Monthly 33, 6, 14-15, June, 1951.

Texas Gulf Producing 300 Tons Daily of Sulfur at New Worland Plant, The Oil and Gas J. 50, 11, 78-79, July 19, 1951.

The Hydrodynamic Lubrication of Sector-Shaped Pads, R. S. Brand, ASME, Semi-Annual Meeting, Toronto, Ontario, Canada, June 11-15, 1951.

Useful Products from Natural Gas, W. C. Holliman, Sixth Annual Short Course in Gas Technology, sponsored by SGA, Texas College of Arts and Industries, Kingsville, Texas, May 30-June 1, 1951.

Economics

Economic Trends in the Utilization of Natural Gas in the Southwest, G. R. Walton, Sixth Annual Short Course in Gas Technology, sponsored by SGA, Texas College of Arts and Industries, Kingsville, Tex., May 30-June 1, 1951.

Gas Accounting for Production Systems, Warren Ditch, Southwestern Gas Measurement Short Course, College of Engineering, The University of Oklahoma, Norman, Okla., April 10-12, 1951.

LAUGH with BARNEY

Coach: What's his name?
Manager: Osscowinsinski.
Coach: Put him on the first team. Boy, will I get even with the newspapers.

POEM OF THE MONTH

Just give me a man
With a million or two,
Or one who is handsome
Would happily do.
A dashing young fellow
Is swell any day,
Or one who is famous
Would suit me okay.
But if the man shortage
Should get any worse,
Go back to the very
First line in this verse.

Take a look at your tax bills and you'll stop calling them "cheap" politicians.

A young lawyer, pleading his first case, had been retained by a farmer to prosecute the railroad company for killing twenty-four hogs. Seeking to impress the jury with the greatness of the loss, he said: "Twenty-four hogs, gentlemen! Twenty-four! Twice the number in the jury box!"

A man is a guy who can spot a trim ankle three blocks away while driving down a busy street at high noon, but who won't notice, in wide-open country, a whistling locomotive the size of a schoolhouse.

Out in the middle of nowhere, two trains sped toward each other on the same track until they collided with a tremendous crash.

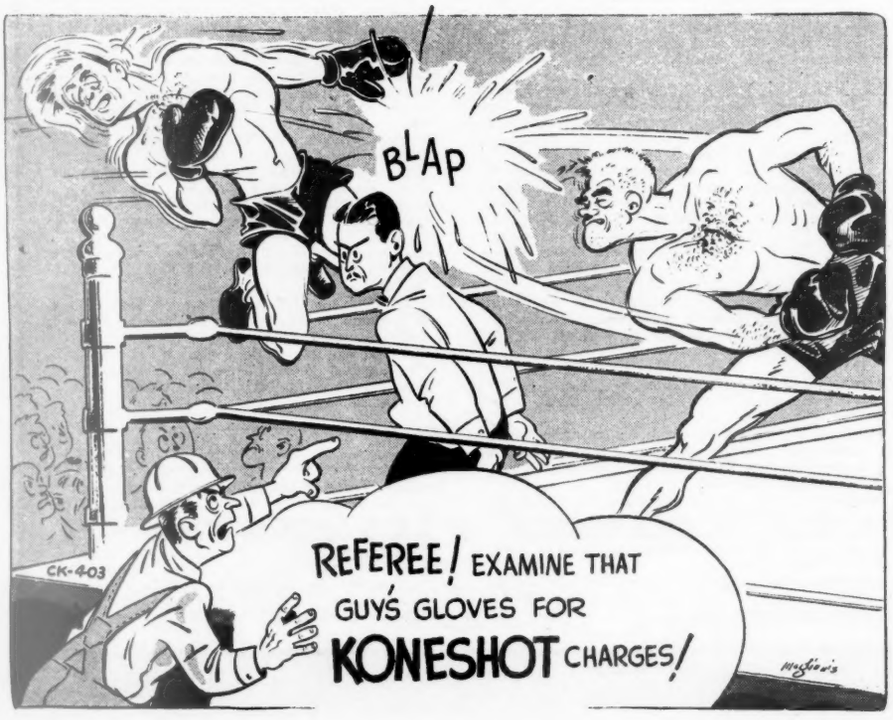
Reporters flocked to the scene, and one of them was questioning Slim, an old cowhand who was the only witness to the disaster.

"Tell me, Slim, what did you think when you saw those two trains coming together?"

Slim drawled his answer: "I thought that was one H..... of a way to run a railroad."

"You are young only once. After that it becomes necessary to think up a new line of excuses for what you do."

"Governor, you promised me a job."
"But there are no jobs."
"But you said you'd give me one."
"Tell you what I'll do; I'll appoint a commission to investigate why there are no jobs, and you can serve on that."



Many a gal will yell when she sees a mouse but thinks nothing of getting in a car with a wolf.

Little Chris (ending prayer): And please, Lord, put the vitamins in pie and cake instead of in cod-liver oil and spinach. Amen.

One business man we know says it's hard for him to decide whether to be a Republican and go to the poorhouse—or be a Democrat and help build them.

A psychiatrist was examining a selectee.
Psychiatrist: What's your occupation?
Selectee: I'm a gag writer for radio.
Psychiatrist: Let's see you invent a gag.
Selectee: (Rising slowly, goes to the door and looks down at the long line of other selectees):
O. K. you guys can go home now, the job's taken.

"What are you studying in college now?" asked the fond mother of her son, who was a freshman engineer.
"We have just taken up molecules."
"That's fine. I hope you will like them, I always wanted your father to wear one, but he couldn't keep it in his eye."

As the after-dinner speaker sat down to his meal, he coughed. His upper plate fell to the floor and broke.
The guest at his side realized the man's plight, dug into his pocket and came up with a set. The speaker-to-be tried them. They were too big. The man supplied another set. They were too small. The third set was a perfect fit.
The speaker got along perfectly with the borrowed teeth, and returned them with thanks.
"By the way," he inquired, "are you a dentist?"
The helpful guest shook his head. "No. I'm an undertaker."

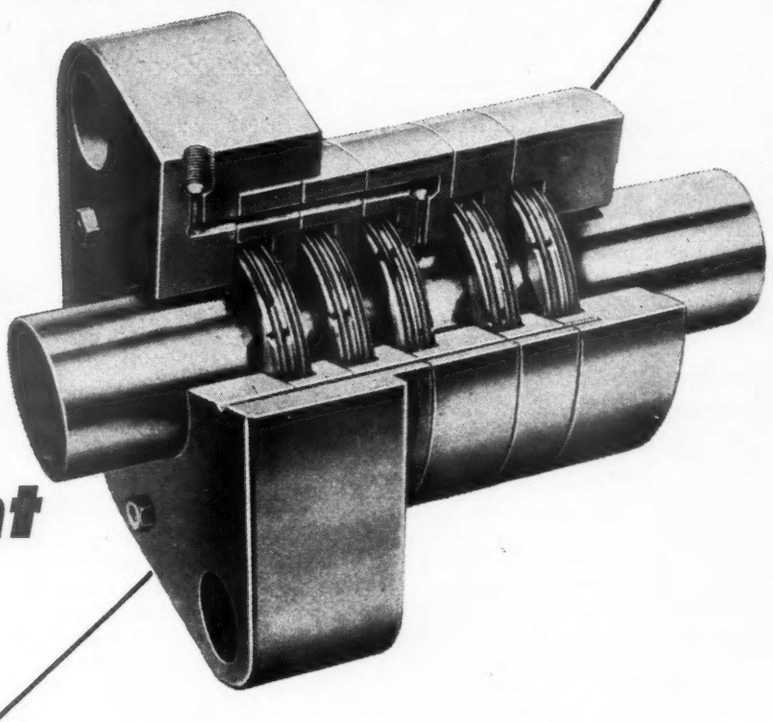
"Did you get that fellow's license number?"
"No, he was going too fast."
"That girl with him was some chicken."
"Yeah. I'll say she was!"

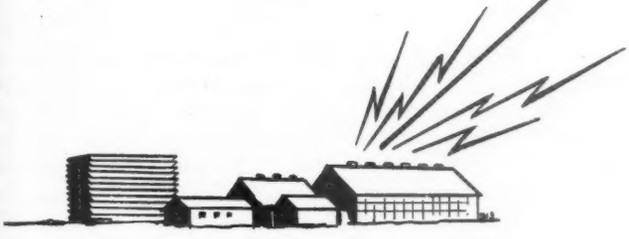
Switch of the week: Old Gardeners never die, they just spade away.

A self styled reformer was watching a trench being dug with modern machine methods. He said to the superintendent:
"This machine has taken jobs from scores of men. Why don't you junk it and put 100 men in that ditch with shovels?"
The superintendent snorted: "Better still, why not put a thousand men in there with teaspoons?"

CALL COOK

. . . for fast service on packing replacement parts!



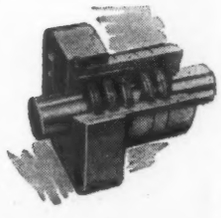


When wearing rings require replacement, you generally need them in a hurry. That's why it will pay you to call COOK whenever packing replacements are needed. Our warehouses are located at strategic points throughout the country and are stocked and ready to give your orders fast, efficient attention. Emergency shipments can be made, in fact, within a few hours time. So, don't take chances with substitutes . . . always insist on genuine COOK packing parts. You'll get them just as fast as they can possibly be delivered.

C. Lee Cook Manufacturing Co., Incorporated, Louisville, Ky. Branch offices in Baltimore, Boston, Chicago, Cleveland, Houston, Los Angeles, Mobile, New Orleans, New York, San Francisco and Tulsa.

COOK GRAPHITIC IRON

ROD PACKINGS



. . . SEALING PRESSURES SINCE 1888 . . .

OIL AND GAS TRADE NEWS

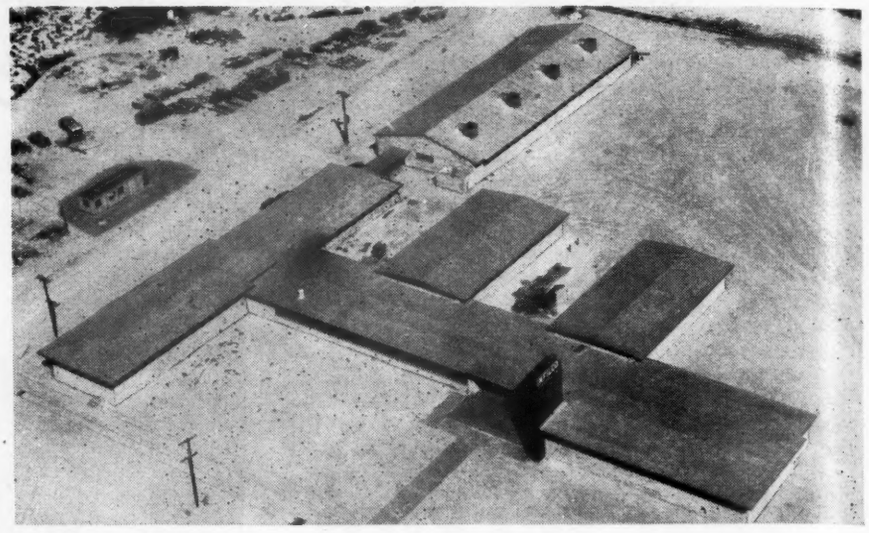
Ensign Carburetor Notes Fortieth Anniversary

Ensign Carburetor Company is celebrating its fortieth anniversary this year. The company was organized in 1911 and has since then expanded to an organization of several hundred employees with three factories, and markets extending throughout the world. Orville H. Ensign, founder of the company, was an early pioneer in gasoline and heavy fuel carburetors for tractors, trucks, marine, and stationary engines. Many improvements in modern internal combustion are credited to him.

Recently added to English's line of equipment is the "combination" carburetor for use with either wet or dry fuels. This makes possible the use of gasoline or butane-propane or natural gas, depending on the type fuel the operator has available.

Socony Subsidiary Set Up

Socony-Vacuum Overseas Supply Company, a new subsidiary of Socony-Vacuum Oil Company, Inc., has set up offices at 158 Linwood Plaza, Fort Lee, New Jersey. The new company was organized to centralize the handling of several aspects of Socony-Vacuum's Eastern Hemisphere operations, which are now divided among various departments of the parent company. It has approximately 90 employees. Robert Siegel has been named president of the new company.

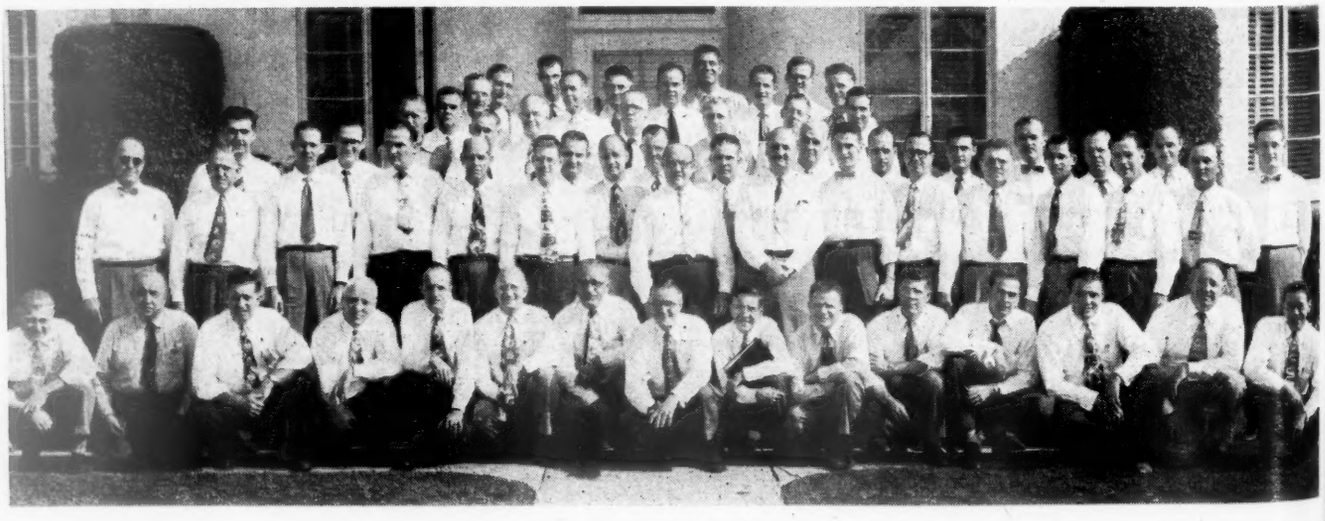


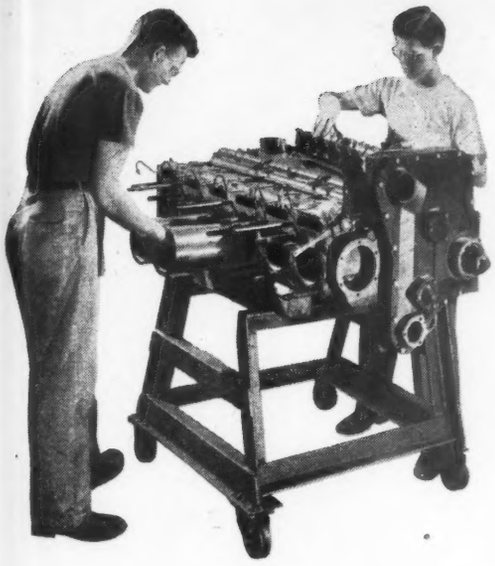
New research and executive headquarters building of Infilco at Tucson, Arizona. The $600,000 building, designed by Paul R. Williams, includes 40,000 sq ft of floor space and will house the most modern facilities for Infilco's engineering, research, and development divisions, as well as the home sales and executive offices.

Boston Woven Hose Plans Rubber Reclamation Plant

Boston Woven Hose and Rubber Company, Cambridge, Massachusetts, has broken ground on a new $1,000,000 rubber reclamation plant. Using an air separation process developed by company engineers, the new factory will help to conserve scarce rubber supplies by extracting all usable material from scrap auto tires, and other waste rubber. The entire output will go into the company's own maufacturing operations, which include a large volume of government orders. It is expected that the plant will be completed sometime in the second quarter of 1952. W. L. Larkin is vice president and treasurer.

First international sales conference held by Chiksan Company was held in Brea, California recently. According to G. R. Winder, vice president and sales manager, the meeting was necessary to keep up with events, markets, and new products being developed. Attending the meeting were: First row, Art Edwards, Sam Blue, Ed Leicester, Elmer Rhodes, Bill Clark, Carl Gast, Frank Wiegand, Bob Perry, Ed Richard, Ed Miller, Floyd Ferguson, Chuck Russell, Joe Schlarb, Ed Landgraff, and Dale Prentice. Second row: Ed Myers, John Rittelmeyer, Harry Rogers, John Gates, Doyle Warren, Bill Connelly, Frank Burrill, Dick Winder, Stew Miller, Frank Land, Mac McCelvey, Nate Zimmerman. Third row: Lee Guill, Al Neely, Hal Stock, Bev Ragsdale, Chub Morrison, Robby Robinson, George Beecroft, Roy Shields, Durk Durkin, Hank O'Breen, Ed Vance, and Lou Smith. Fourth row: Walt Berntsen, Rollo Stover, Art Stoeltzing, Moff Moffitt, John Schmidt, Bob James, Bill Cone. Fifth row: Doc Brill, Kenny Knutzen, Neil Thomas, Bob Jones, and Pete Bily. Back row: Gus Bagnard, Chuck Holcomb, Bernie Coane, Foster Jordan, and George Cousins. Attending but not shown are Don Jackson, Roy Irvin, and Howard Dickson.

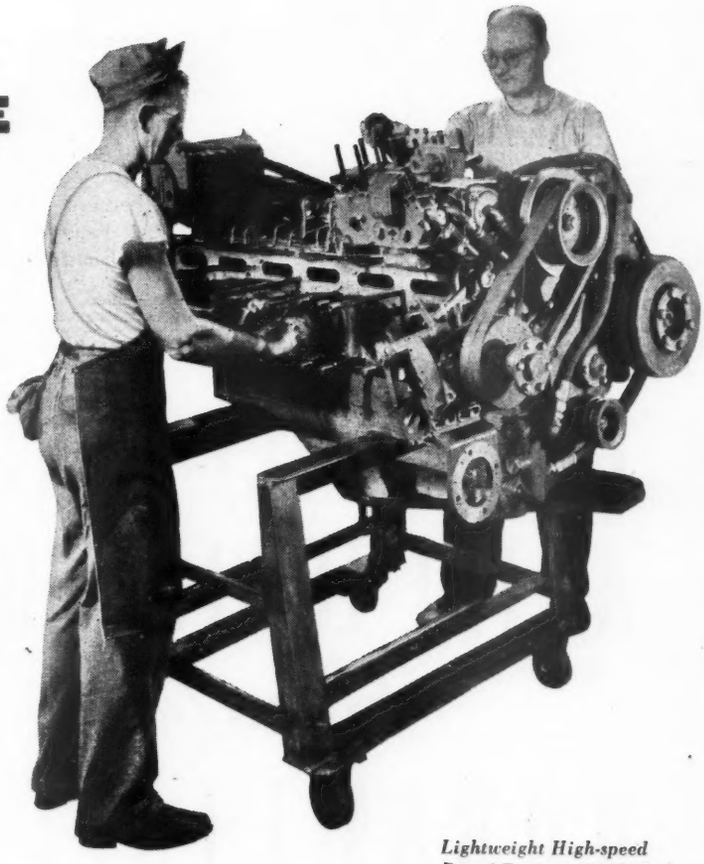




Cummins®
CUSTOM BUILT Diesels

BUILT NOT ONCE BUT TWICE

You get more power and profits with Cummins Diesels. They're custom-built to fit your job, and your equipment. And they are literally built *not once but twice.* Each engine is assembled, run-in tested, disassembled . . . inspected, reassembled and *tested* again. Such precision building, Cummins exclusive fuel system, efficient service and parts organization . . . mean *less* "down-time" and *more* profitable power from every Cummins Diesel Engine. *See your Cummins dealer.*



CUMMINS ENGINE COMPANY, INC., COLUMBUS, INDIANA
Export: CUMMINS DIESEL EXPORT CORPORATION Columbus, Indiana, U.S.A. • Cable: CUMDIEX

Lightweight High-speed Diesel Engines (50-550 hp)
for: on-highway trucks
off-highway trucks • buses
tractors • earthmovers
shovels • cranes
industrial locomotives
air compressors
logging yarders and loaders
drilling rigs
centrifugal pumps
generator sets and power units
work boats and pleasure craft

Diesel power by CUMMINS

CUMMINS Dependable DIESEL

TRADEMARK REG. U. S. PAT. OFF.

Cleco Appoints Agens

The Cleco Division of the Reed Roller Bit Company, Houston, Texas, has announced the appointment of Harris Pump and Supply Company, Brady and Sidney Streets, S. S., Pittsburgh, 3, Pennsylvania, as distributors for Cleco products in their area. Cleco manufactures the Cleco and Dallett lines of air tools and accessories.

New Forged Rock Bits Set for Production

Mackintosh-Hemphill Company has entered a new field of steel manufacture and is currently producing a line of forged steel rock bits that are being distributed by a newly-organized subsidiary company to the mining, quarry, construction, and other heavy industries. Col. James S. Ervin, president of Mackintosh-Hemphill, has announced formation of the company's Drill Bit and Tool Division. This new division is charged with the research, development, and manufacture of a line of disposable rock bits. These bits are being manufactured in a new building adjacent to the company's Midland plant at Midland, Pennsylvania.

The sale of the "DBT Throwaway" rock bits through contractor and mine supply houses is the responsibility of Drill Bit and Tool Company. This is a newly-organized Delaware corporation and is a wholly owned subsidiary of Mackintosh-Hemphill.

E. D. Bransome, president of Mack Trucks, lays cornerstone of the company's service parts division building, in Bridgewater, New Jersey. Looking on are G. C. Grantham, Mack's director of parts supply and control; George F. Smith, president of Johnson and Johnson and member of the board of directors of the Regional Plan Association and vice-chairman of the New Jersey Turnpike Authority; Presley L. Lancaster, Jr., deputy director of the Industrial Dispersion Task Force of the National Security Resources Board; Brigadier General William L. Barriger, chief of staff, First Army, and James A. Garrison, deputy assistant administrator of the Federal Civil Defense Administration.

FOR PERFECT SEALING
AT THE LOWEST COST
Specify
DURAMETALLIC
PACKINGS

The PERFECT SEAL

DURAMETALLIC CORPORATION, *Kalamazoo, Michigan*
Sales and Service Offices Thruout the United States and Canada

MERCOID

THEY ARE USED FOR THE CONTROL OF TEMPERATURE, PRESSURE, LIQUID LEVEL AND MECHANICAL OPERATIONS.
THE MERCURY SWITCH IS A FEATURE IN MERCOID CONTROLS. THE REASON FOR THE MERCURY SWITCH IS THE ADDED SAFETY, BETTER PERFORMANCE AND LONGER CONTROL LIFE—ALL OF WHICH ARE IMPORTANT WHEREVER CONTROLS ARE REQUIRED. WHY CONSIDER LESS WHEN YOU CAN GET SO MUCH MORE.

WRITE FOR COMPLETE CATALOG

THE MERCOID CORPORATION
4201 BELMONT AVE. CHICAGO 41, ILL.

M. L. Walraven, Jr.

W. R. Foster

Dempsey Pump Handled By Specialty Sales

Byron Jackson Company announces that an agreement has been reached with Specialty Sales and Service, Inc., of Tulsa, Oklahoma, whereby that firm will handle all sales of the Dempsey hydraulic oil well pump as the exclusive sales agent for Byron Jackson Company, Dempsey Division, in the Mid-Continent area. This agreement permits Specialty to continue to perform a service that it had done as representative of the Dempsey Pump Company of Tulsa prior to the recent purchase of that company by Byron Jackson Company.

The first step in a planned expansion program was taken recently, with the opening of an office in Fort Worth, Texas, headed by W. R. Foster. M. T. Walraven, president, will head Specialty Sales and Service, Inc.

Cleco Appoints Agents

The Cleco Division of the Reed Roller Bit Company, Houston, Texas, has announced the appointment of The W. S. Ehrenfeld Company, 531 West King Street, York, Pennsylvania; Hillsman Equipment Company, Melrose Park, Illinois; and R. W. Hudgins and Sons, 1-3 Commerce Street, Norfolk 10, Virginia, as distributors for Cleco products in their areas. Cleco manufactures the Cleco and Dallett lines of air tools and accessories.

Gulf Coast Offices Opened

M. H. Detrick Company, Chicago, Illinois, has opened a new Texas and Gulf Coast district sales and service office at 2284 West Holcombe Boulevard, Houston, Texas. George C. Sorensen is district manager.

Marley Moves Into New General Office Building

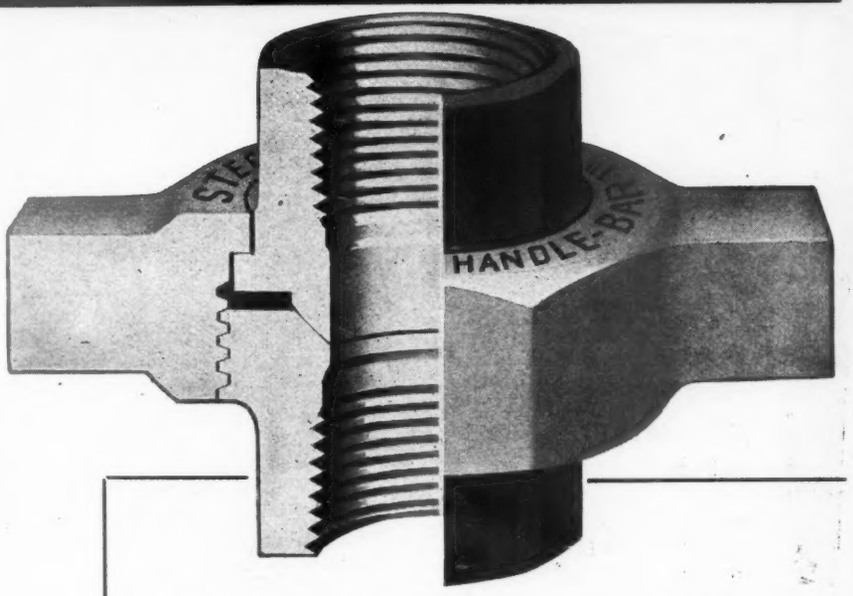
Expanded business and increased demand for Marley products has resulted in the move of the Marley Company to 222 West Gregory Boulevard, Kansas City 5, Missouri. Enlargement of the adjacent airport at the Fairfax location precluded expansion of either the plant or general office, both laterally and vertically. Added height to the building would change the glide angle runways, so the general office departments have been taken over for increased manufacturing facilities. The new building houses sales, engineering, executive, accounting, and production departments.

The Tool Pusher's Best Friend

HANDLE-BAR

REG. U.S. PAT. OFF.

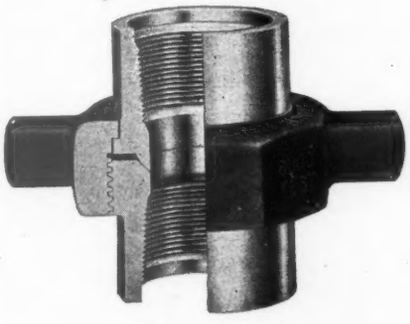
Forged Steel Unions



HANDLE-BAR 4000 TEST

REG. U. S. PAT. OFF.

HANDLE-BAR Unions are precision made and tested at time of manufacture to assure a tight seal in seats and threads. These famous features are built into each HANDLE-BAR. Integral steel to steel or bronze to bronze seats. Hub ends tapped Briggs Standard steam threads. Nut threads modified Acme. Furnished black hub ends with Udylite nut, or all rust-proof with Udylited hub ends and Parkerized nut. Recommended for all services and on pressures to 3000 lbs.



HANDLE-BAR 6000 TEST

REG. U. S. PAT. OFF.

These unions have integral steel to steel seats. The hub ends are tapped A.P.I. line pipe. The nut threads are modified Acme. The hub ends are rust-proofed and spark-proofed with Udylite Cadmium. The nut is Parkerized. These unions are recommended for all oil field services and pressures to 5000 lbs.

Write Dept. P for illustrated catalog or refer to listings in Composite Catalog pages 3140-3141, Refinery Catalog page 538, and Chemical Engineering Catalog pages 980-981.

ORDER BY TRADE NAME FROM YOUR LOCAL JOBBER

ORIGINATORS AND PIONEERS OF STEEL UNIONS SINCE 1912

CLAYTON MARK & COMPANY

1900 DEMPSTER STREET • EVANSTON, ILLINOIS

NEW!
CHROME-CLAD
MEZURALL
"10-FOOTER"
TAPE-RULE
No. C-9210

CHROME-CLAD BLADE
EASIER READING
LONGER WEARING
SELF-ADJUSTING HOOK
REPLACEABLE BLADES

With the new *Mezurall "10-Footer"* Tape-Rule you can save time and insure greater measuring accuracy on all types of shop work beyond the capacity of regular 6 or 8-foot Tape-Rules. Check all these features:

- **Non-glare *Chrome-Clad* satin finish blade will not crack, chip, peel, or corrode.**
- **Durable Black Markings that stand out sharply against chrome white background.**
- **Self-Adjusting End Hook that permits accurate butt-end and hook-over measuring.**
- **Replaceable blades. Patented safety catch simplifies changing blades.**
- **Improved, Heavily Plated Case with inset side plates in attractive red and white.**

A "natural" for measuring large steel sheets, plywood, linoleum and for countless other important industrial uses.

Your Supply House has them . . . specify No. C-9210 10-ft. Chrome-Clad Mezurall. Also available with nickel plated blade, specify No. 9210.

96-C

BUY LUFKIN TAPES · RULES PRECISION TOOLS

THE LUFKIN RULE CO.
SAGINAW, MICH. • New York City • Barrie, Ontario

Schlumberger Sets Up Three New Offices

J. E. Young

Schlumberger Well Surveying Corporation has added three new locations to its list of service centers. Moving into Williston Basin, which is potentially one of the major areas to be opened in recent years, the company has set up an office in Williston, North Dakota. This station, opened September 16, is managed by J. E. Young. A member of the Schlumberger organization since January 1948, Young has worked in Montana and Wyoming districts.

A new location at McCamey, Texas, was opened on September 1, to place equipment near the point of operations. This station is in the charge of D. M. Quillan, who has been employed by Schlumberger since February 1949, serving in the Permian Basin area.

In the Rocky Mountain area a new station was established on August 27, at Vernal, Utah, to handle the new discoveries and increased exploration in that region. John Rusen was transferred from Casper, Wyoming, to take charge of this station. He has served in the Rocky Mountain area since his employment in February 1948.

Contest Rules Published

The rules and conditions for the fifth annual competition of the Lincoln Arc Welding Foundation's Engineering Undergraduate Award and Scholarship Program are now available in a 24-page illustrated booklet. The booklet shows pictures of the design and research projects described in award papers of previous competitions. Brief descriptions of last year's award papers are also presented along with a bibliography of welding texts and references. All registered undergraduate engineers are eligible to compete. Awards totaling $675 are made for the best papers on design of machines or structures, or separate components of machines or structures in which arc welding is the method of fabrication. Welding research and maintenance projects can also be described.

Trailmobile Sets Up Georgia Factory Branch

Establishment in Birmingham, Alabama, of a new factory branch of Trailmobile, Inc., manufacturers of commercial truck-trailers, and the appointment of W. C. Griffin of Birmingham as branch manager is announced by W. A. Burns, Jr., vice president and sales manager. Since March, 1950, Trailmobile has been operating its Birmingham sales activity as a sub-branch under Atlanta, Georgia, and has now raised its Birmingham operation to full branch status. Griffin joined Trailmobile in 1949 and was employed as a resident salesman in the Atlanta branch until the establishment of the sub-branch in Birmingham, where he has been since.

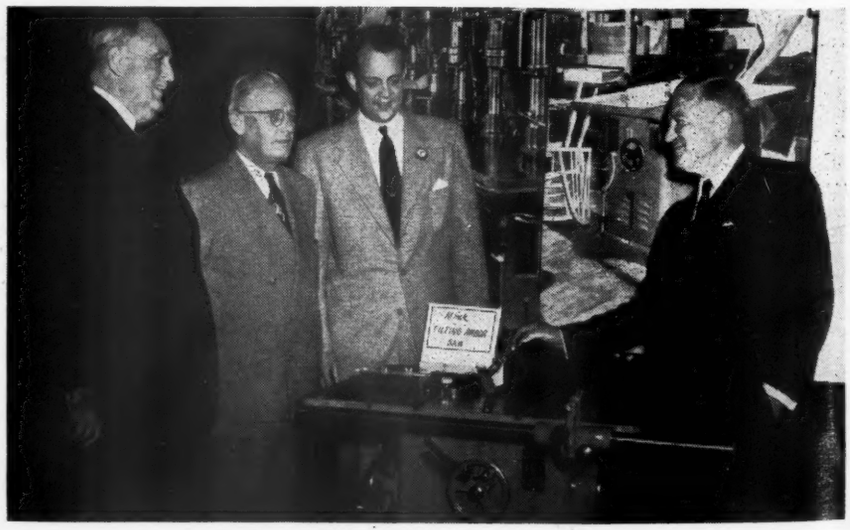
R-S Houston Office Is Being Re-opened

The Refinery Supply Company of Tulsa, Oklahoma, has announced the re-opening of the Houston, Texas, branch at 2215 McKinney Avenue. This company is the sole manufacturer of R. S. oil and gas testing specialties, and also exclusive distributors for the Central Scientific Company (Cenco).

As far as possible under present conditions, a complete line of laboratory equipment will be carried.

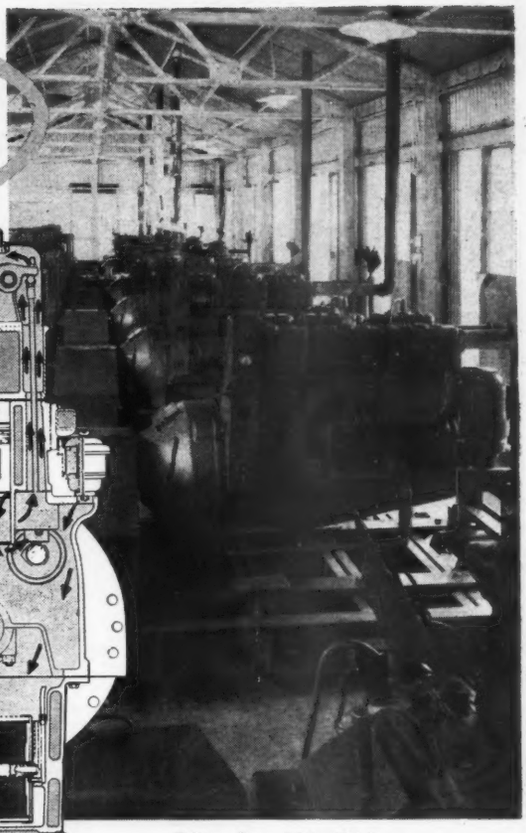
V. F. Sweeney, Jr., will be in charge of the branch.

Rockwell Manufacturing Company's latest plant was dedicated recently in Tupelo, Mississippi. A number of top state officials were on hand for the occasion. At left is Governor-elect Hugh L. White, Governor Fielding Wright, H. Campbell Stukeman, vice president, and Colonel W. F. Rockwell, chairman of the board.



MINNEAPOLIS MOLINE
MM
MODERN MACHINERY

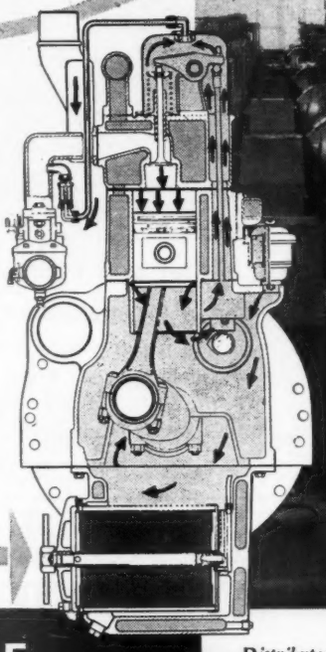
OILFIELD POWER
WITH HEAT EXCHANGER BASE PAN!



MM HEAT EXCHANGER BASE PAN maintains uniform operating temperature from top to bottom of the engine regardless of load or atmospheric temperature. This results in a sludge-free engine . . . best oil filtering . . . greatly extended periods between servicing . . . far fewer oil changes . . . and greatly prolonged engine life.

HERE'S HOW IT WORKS: The base pan is cast with water jackets just like the cylinder blocks and heads. A heavy-duty by-pass thermostat diverts the water from the outlet manifold through the base pan jacket and back through the pump and engine. Circulating the hot water around the oil in the pan eliminates outside radiation and maintains 165-180° temperature for ideal lubrication and filtering.

Positive Vacuum Crankcase Ventilation draws 2 to 3 cu. ft. of fresh air per minute through a metering valve. After mixing with oil-contaminating gases, raw and burned, it is withdrawn through the cylinder head covers and into the intake manifold. Investigate MM Oil Field Power . . . the engine with lower field service cost.



MINNEAPOLIS-MOLINE
MINNEAPOLIS 1, MINNESOTA

7 Sizes from 25 to 180 hp
Distributed by SHRIMPTON MANUFACTURING AND SUPPLY CO. . . . Los Angeles, California; Oklahoma City, Oklahoma; Kilgore, Texas

REALLY LIVE at an
Affiliated National Hotel

Comfortable Rooms

Delicious Meals

Conveniently Located in 21 Prominent Cities

Superb Service

AFFILIATED NATIONAL HOTELS

ALABAMA
HOTEL ADMIRAL SEMMES.....Mobile
HOTEL THOMAS JEFFERSON..Birmingham

DISTRICT OF COLUMBIA
HOTEL WASHINGTON.....Washington

INDIANA
HOTEL CLAYPOOL.....Indianapolis

LOUISIANA
JUNG HOTEL.....New Orleans
HOTEL DESOTO.....New Orleans

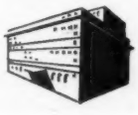
NEBRASKA
HOTEL PAXTON.....Omaha

NEW MEXICO
HOTEL CLOVIS.....Clovis

SOUTH CAROLINA
HOTEL WADE HAMPTON.....Columbia

TEXAS
HOTEL STEPHEN F. AUSTIN.....Austin
HOTEL EDSON.....Beaumont
HOTEL BROWNWOOD.....Brownwood
HOTEL BAKER.....Dallas
HOTEL TRAVIS.....Dallas
HOTEL CORTEZ.....El Paso
HOTEL BUCCANEER.....Galveston
HOTEL GALVEZ.....Galveston
HOTEL JEAN LAFITTE.....Galveston
CORONADO COURTS.....Galveston
MIRAMAR COURT.....Galveston
HOTEL CAVALIER.....Galveston
HOTEL PLAZA.....Laredo
HOTEL LUBBOCK.....Lubbock
HOTEL FALLS.....Marlin
HOTEL CACTUS.....San Angelo
HOTEL MENGER.....San Antonio
ANGELES COURTS.....San Antonio

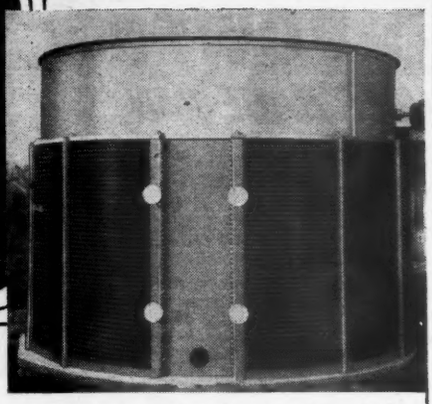
VIRGINIA
HOTEL MOUNTAIN LAKE..Mountain Lake
HOTEL MONTICELLO.....Norfolk



WASHINGTON
Washington, D. C.

BAKER
Dallas, Tex.

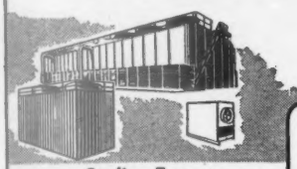
The NEW
Pritchard Quality
QUINTAIR*
AIR COOLED
HEAT EXCHANGER



For Low Cost, Dependable

Cooling of Engine Jacket Water and Lubricating Oil

- Lower Installed Cost
- Higher Efficiency
- Fewer Parts to Assemble
- Lower Maintenance Costs
- Lower Operating Costs
- Many Industrial Uses



Cooling Towers
Gas & Air Treating
Specialized Heat Exchangers

Write for Bulletin No. 11.0.080

*Registered Trade Name

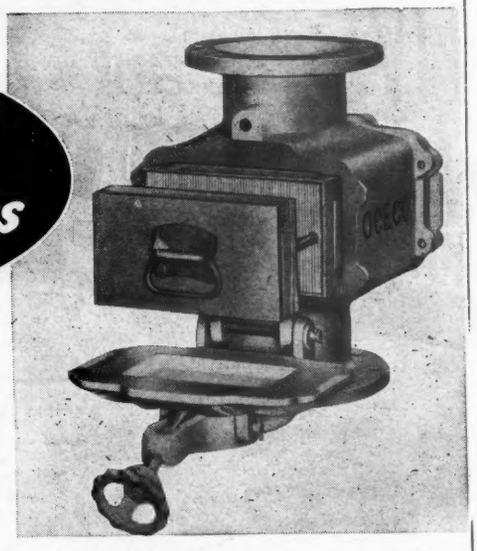
Producers of QUALITY Specialized Process EQUIPMENT

J.F. Pritchard & Co.
EQUIPMENT DIVISION
Dept. 224 908 Grand Ave., Kansas City 6, Mo.

District Offices: CHICAGO • HOUSTON • NEW YORK • PITTSBURGH
TULSA • ST. LOUIS • Representatives in Principal Cities from Coast to Coast

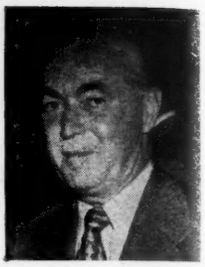
OCECO
Flame Arrestors

are a
DEPENDABLE
Flame Stop



● These arrestors combine the desired flame stoppage and explosion prevention with minimum pressure drop. Sturdy, rugged semi-steel housings and covers. Corrosion resistant aluminum "banks" have vertical straight through passages, minimizing clogging and simplifying inspection;— extensible for easy cleaning. 2" to 10" sizes. *Write for Bulletin No. 471-R. It gives full details.*

OCECO TANK FITTINGS
THE JOHNSTON & JENNINGS CO.
division of PETTIBONE MULLIKEN CORP.
4751 West Division St. • Chicago 51, Illinois



Carey O'Connor, son of Dresser Industries' vice president, John B. O'Connor, right, at annual convention of American Association of Oilwell Drilling Contractors in Fort Worth, Texas. Carey O'Connor won the distinction of being the representative who travelled the farthest distance to attend the important conclave. He traveled from Rio de Janeiro, Brazil, to the Fort Worth event by plane.

Marley Opens New Washington Office

The Marley Company, Inc., manufacturers of Marley water cooling towers and air-cooled heat exchangers, announces the opening of its Washington, D. C., engineering service office. The office is in the Wyatt Building at 777 Fourteenth Street, N. W. Don Cousins, formerly associated with the engineering and sales departments of the company in Kansas City, has been named manager of the Washington office. Cousins is a graduate of the School of Engineering of the University of Kansas.

Thompson Tours Venezuela

Neal B. Thompson, president of Ken Corporation, manufacturers of Ken-Oil drilling fluid and Ken-Pak casing protector, flew to Caracas, Venezuela, recently. During his visit he is conferring with members of Petroleum Industries Consultants C.A., which represents Ken Corporation in that area. Thompson plans to advise the firm regarding any special drilling problems met with in the South American territory.

Permian Basin Activities

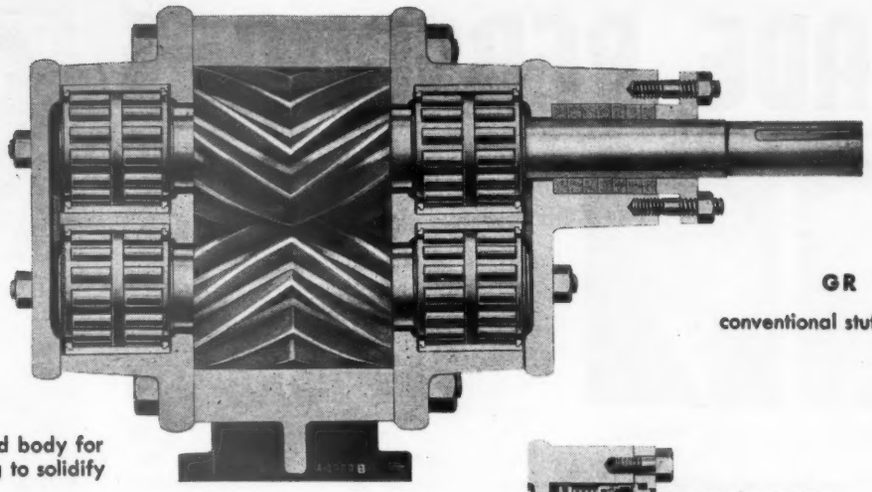
Stentz Equipment Company has recently expanded their sales organization to include offices and warehouse facilities in the Permian Basin of West Texas. Al W. Tweelings, who was formerly with the Gulf Oil Corporation as petroleum engineer, has been appointed district manager.

A. W. Tweelings

Tweelings is a native of Minneapolis, and received his engineering degree from the University of Minnesota. His oil field experience has been quite varied, having worked in geophysical, production, and pipe line operations, prior to his petroleum engineering experience with Gulf.

GRJ

steam-jacketed body for liquids tending to solidify

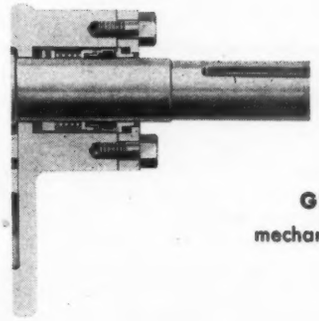


GR

conventional stuffing box

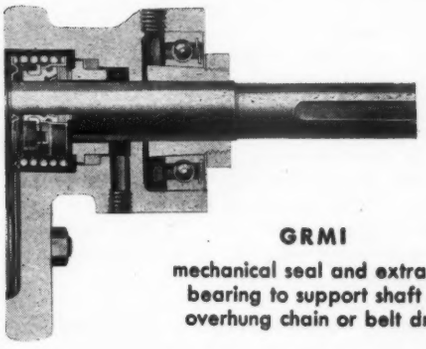
NOW...the most complete line of gear pumps

with interchangeable stuffing boxes to meet varying job requirements



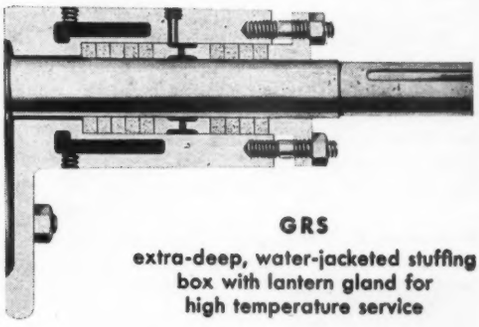
GRM

mechanical seal



GRMI

mechanical seal and extra ball bearing to support shaft for overhung chain or belt drive



GRS

extra-deep, water-jacketed stuffing box with lantern gland for high temperature service

There's a Worthington gear pump now for every service where you want a rotary.

Worthington's GRM with mechanical seal rounds out a line of internal roller bearing rotaries that will fill any requirements from 1 to 5000 gpm; pressures up to 500 psi.

Using the same body, gears and shaft, you can now have a Worthington gear pump for any sealing problem—as shown in the illustration. All parts are interchangeable.

The single stuffing box is subject to suction pressure only.

Better Efficiency, Longer Life with Herringbone Gears

Worthington uses double helical gears on its gear-type rotaries in order to eliminate end thrust, prevent trapping of the liquid, reduce wear on bearing surfaces.

All shafts and plates are the same size for easy interchangeability.

So this new rotary again illustrates the *completeness* of the Worthington line—the fact that "The World's Broadest Line Assures You the Right Pump for Every Job".

Send coupon for new bulletin on Worthington gear-type rotaries. Please attach to your business letterhead.

WORTHINGTON

ROTARY PUMPS

P.1.7

Worthington Pump and Machinery Corp.
Reciprocating Pump Division
Harrison, New Jersey

NAME.....TITLE.....

COMPANY.....

ADDRESS.....

CITY.....ZONE.....STATE.....

TRADE PERSONALS

L. J. Smith

G. R. Winder

L. J. Smith has been appointed to the newly-created position of eastern regional sales manager by the Chiksan Company, Brea, California. This move has been made necessary by the increasing demand for Chiksan swivel joints and Weco quick-coupling unions. Smith's headquarters will be the company's Newark, New Jersey office, where he has served as a field engineer for the past four years. G. R. Winder, vice president and sales manager, made the announcement.

Jack Judd of the Houston, Texas, branch of Orbit Valve Company has been transferred to the Midland, Texas, office and **L. E. "Ed" Wallace,** who was formerly at Corpus Christi, Texas, has gone to the Houston branch.

Ralph H. Soape will take over the Corpus Christi territory. Before coming to Orbit Valve Company, Soape had been associated with the Republic Supply in southwest Texas.

Cooper Vaughn, manager at McAllen, Texas, for the Continental Supply Company, has been transferred to Alice, Texas, in the same capacity.

M. H. Johnson, formerly of Corpus Christi, has been appointed manager of the McAllen store.

Both points are under the direct supervision of W. E. Young, assistant district manager, Corpus Christi, and N. A. Endicott, vice president, Houston.

Samuel P. Owen, advertising specialist in the portable power tool industry, has recently been appointed advertising manager of the Rockwell Tools, Inc., Columbus, Ohio. This firm was recently acquired by the Rockwell Manufacturing Company to augment their Delta power tool division. Owen was formerly assistant advertising manager of Skilsaw, Inc.; and prior to his new appointment, served in a copy, contact, and planning capacity with Marsteller, Gebhardt, and Reed, Inc., Chicago, advertising agency for all divisions of Rockwell.

S. P. Owen

J. W. Spoor has been named general sales manager of the welding products division of A. O. Smith Corporation at Milwaukee, Wisconsin. **L. F. Vonier,** former sales manager, is moving into the newly-created position of sales promotion manager, where he will assist division manager L. T. Hickey and Spoor in expanding A. O. Smith's sales of both welding electrodes and welding machines.

Spoor was formerly manager of A. O. Smith's product service division. Succeeding him as product service division manager is **Charles Smith,** formerly field service manager. Vonier has been a leading figure in the development of A. O. Smith's welding electrode business since 1937, introducing to the industry the SMITHway Certified electrodes.

H. A. Wyckoff

W. K. Waters

Harry A. Wyckoff, a veteran of 15 years' service with Otis Pressure Control, has been appointed superintendent of Otis' Oklahoma City division. He joined Otis in 1936, working out of Ada, Oklahoma. He has been dispatched to supervise unusual pressure control jobs from the Gulf Coast area to the Arctic Circle and from California to the Eastern Seaboard.

W. K. (Jug) Waters, formerly with Otis Pressure Control's Odessa, Texas, office, has been appointed assistant superintendent of the firm's Oklahoma City Division to replace Wyckoff. Prior to his Odessa assignment Waters was employed in Otis' manufacturing plant in Dallas. He was graduated from Southern Methodist University.

James E. Boudreau has been appointed director of public relations of Ethyl Corporation. He succeeds **Ralph C. Champlin,** who has resigned to become a vice president of the Pennsylvania Railroad Company. Boudreau has been associated with Ethyl Corporation for 21 years in various sales, customer services, and advertising capacities.

Joining the corporation as a sales representative in New York State, Boudreau two years later was named manager of the New York sales division and in 1936 became manager of the Chicago sales division. In 1944 he was named advertising manager of Ethyl.

A. G. Van Campen

R. C. Smith

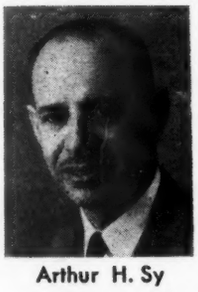
A. G. Van Campen has been appointed district sales manager of the Tulsa Mid - Continent territory by Clark Bros. Company, Inc., Olean, New York. Van Campen has been with the company for 15 years. His sales experience with Clark consists of four years in the New York office and more recently as district sales manager of the Chicago territory. He will assume the Tulsa position vacated by the appointment of George W. Probst as western regional sales manager.

M. G. Daniels

Robert C. Smith has been appointed Chicago district sales manager by Clark Bros., to succeed Van Campen. Trained and experienced on heavy construction projects in the Pacific northwest, Smith also has spent a number of years on the Pacific Coast with a major oil company as a project engineer on refinery construction. During the war Smith served with the materials division of the Petroleum Administration for War.

M. G. Daniels has been named industrial sales engineer in the Chicago office. A graduate of the University of Michigan, Daniels has a background of eight years of selling compressors, pumps, and engines to the industrial markets. In his new position he will concentrate his efforts on the industrial compressor applications in the Chicago territory. The Chicago office, situated at 122 South Michigan Avenue, is managed by Smith.

Arthur H. Sy, formerly sales manager, has been named vice president in charge of sales for American District Steam Company, Inc., North Tonawanda, New York. He has been with the company since 1923, serving in various capacities in production, engineering and sales, becoming sales manager in 1946. Sy will have complete responsibility for main office sales functions as well as supervision of five district sales offices in Buffalo, Chicago, New York, Philadelphia and Pittsburgh and the 46 manufacturers' representatives serving ADSCO in 70 cities.



Arthur H. Sy

William S. Sisson has been named power industry manager for Minneapolis-Honeywell Regulator Company. Now industrial manager of the company's Indianapolis office, Sisson will promote product sales in the central station and power fields. **George M. Rossiter** is being transferred from the Milwaukee office to Indianapolis where he will become industrial manager succeeding Sisson.

W. R. Leopold

D. L. Gallagher

W. R. Leopold, assistant to the vice president, has been appointed to direct the operations of the public works division of Worthington Pump and Machinery Corporation, Harrison, New Jersey. **D. L. Gallagher,** former assistant manager, has been appointed manager of the division. Leopold joined Worthington in 1917 and later that year he was appointed a meter salesman in the New York office. Gallagher was graduated from Rensselaer Polytechnic Institute. After seven years with the New York Power and Light Corporation he joined Worthington in 1937.

Donald Moore has been named national sales representative for the Everett trencher, McGee scraper, and angle dozer, by The Tractor Sales Corporation, Los Angeles. These three industrial implements are distributed nationally by Tractor Sales. Before joining Tractor Sales, Moore was assistant sales manager of The Skyline Corporation. He attended Fullerton Junior College.

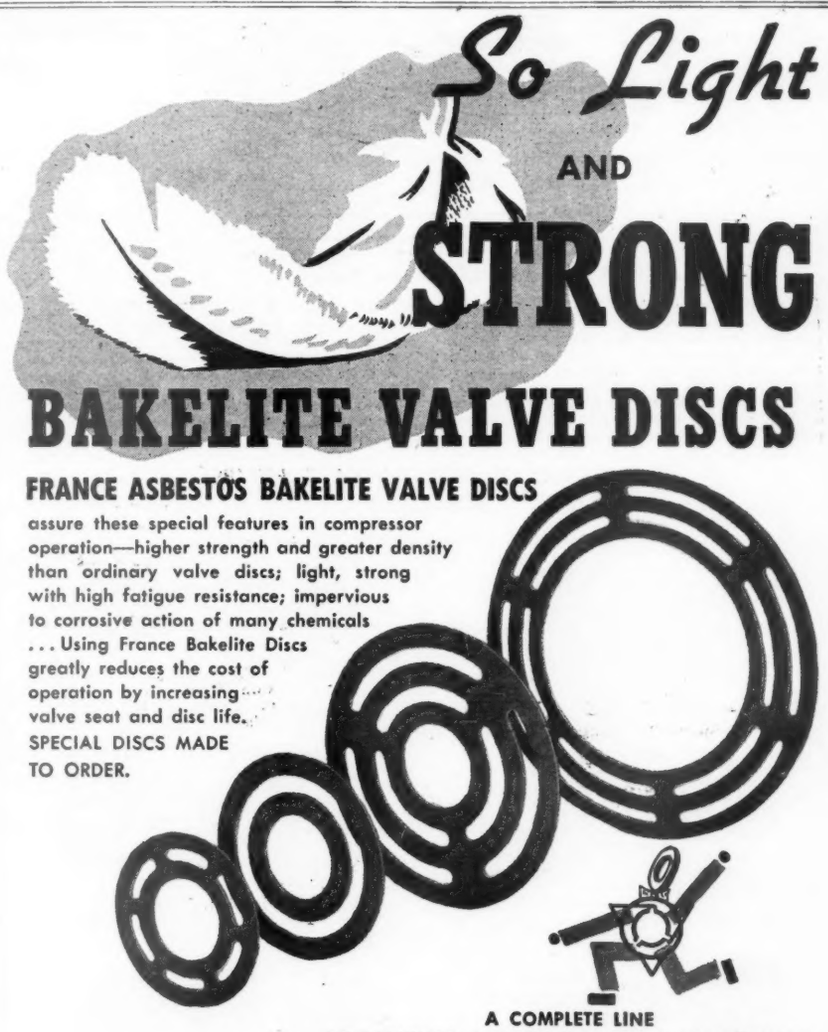
J. P. "Pete" Peterson has been promoted from eastern credit manager to assistant general credit manager, Halliburton Oil Well Cementing Company. The new position brings Peterson from Flora, Illinois, to Halliburton's Duncan, Oklahoma, headquarters. **Lester S. Dunlevy,** who has been fieldman at Halliburton's Olney, Illinois camp, assumes Peterson's former position of eastern credit manager. Peterson brings 11 years of Halliburton field work and credit experience to his new post. From 1940 until 1947 he worked in the service company's Gulf Coast operations transferring to Halliburton's Eastern Division in 1947. He attended the University of Kansas.

J. P. Peterson

Kenneth S. Ross has been named head of the export sales department in New York City for Baash - Ross Tool Company. He was formerly with the California division of the company. After an extensive period of field work with one of the major drilling contractors where he learned oilfield operations from the ground up, Ross joined the Baash-Ross organization in the Los Angeles plant. Here he worked up through various departments of the organization, then was transferred to the Bakersfield and San Joaquin Valley where he has been until his recent promotion. Ross will make his headquarters at 11 West 42nd Street, New York City.

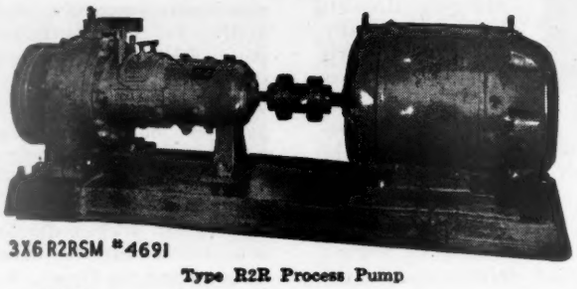
Kenneth S. Ross

R. H. Sturges, former assistant merchandising manager and operations auditor for Mid-Continent Supply Company, has been appointed to the position of purchasing agent. Sturges joined Mid-Continent in 1944 as assistant department manager, merchandise department, and was then successively made assistant merchandising manager and operations auditor. Prior to his association with Mid-Continent, he had been field store auditor for another company. He attended the University of Colorado. His offices are in Fort Worth.

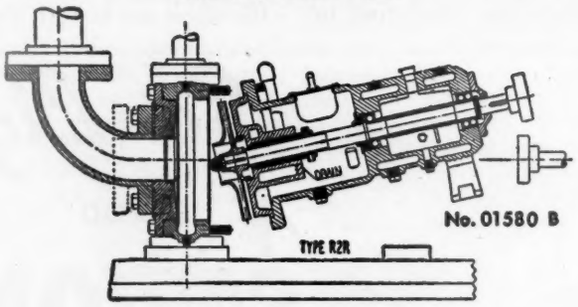

So Light
AND
STRONG
BAKELITE VALVE DISCS
FRANCE ASBESTOS BAKELITE VALVE DISCS
assure these special features in compressor operation—higher strength and greater density than ordinary valve discs; light, strong with high fatigue resistance; impervious to corrosive action of many chemicals ... Using France Bakelite Discs greatly reduces the cost of operation by increasing valve seat and disc life.
SPECIAL DISCS MADE TO ORDER.
A COMPLETE LINE
OF PACKINGS AND PISTON RINGS FOR INDUSTRY
FRANCE PACKING CO.
PHILA. 35, PA.
METALLIC PACKINGS
POWER PISTON RINGS
CARBON-BAKELITE LIQUID PUMP & COMPRESSOR PISTON RINGS
VALVE DISCS

DEAN BROTHERS PUMPS INC.

Type R2R Centrifugal Process Pumps



Type R2R Process Pump



Type R2R Process Pump

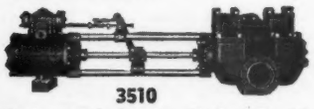
DISASSEMBLY: The Type R2R processs pumps can be disassembled without disconnecting the suction and discharge piping. By first removing the spacer from the spacer type coupling, and unbolting the casing from the cradle the entire cradle and complete rotating element can be removed without disturbing the suction and discharge piping.

OPERATING RANGE: Type R2R, Heavy duty, process pumps are available in eighteen different sizes, enabling our engineers to furnish units specially designed and constructed for the particular work to be performed.
Capacities: 50 to 2000 Gallons per minute. Heads: Up to 400'. Speeds: 900 RPM to 4000 RPM.

BUILDERS OF OUTSTANDING PUMPS SINCE 1869

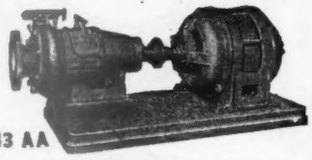
CENTRIFUGAL and RECIPROCATING PUMPS

Close Coupled Centrifugal Pump



3510

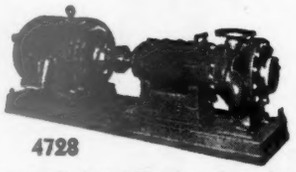
Horizontal, Single Style, Double Acting, Piston Type. Close Clearance Pump. Designed to handle volatile liquids



Pedestal Mounted Centrifugal Pump

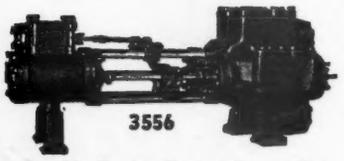
3833

Horizontal, Duplex, Double Acting, Side Pot, Piston Type, Oil Bath Power Pump



4728

Double Pedestal Bearing Centrifugal Pump



3556

Durable Duplex Packed Piston Pattern Steam Pump, Side Pot Type

ESTABLISHED 1869

DEAN BROTHERS PUMPS INC.

INDIANAPOLIS IND.

323 W TENTH ST.

Branch Offices: NEW YORK, N. Y., HOUSTON, TEXAS

Representatives in Principal Cities

V. R. Farlow

G. L. Glespen

▸ **V. R. Farlow** has been named sales supervisor and **G. L. Glespen** as technical supervisor of the petroleum chemicals department, American Cyanamid Company. Since 1945, Farlow has been technical representative on petroleum chemicals in the company's Chicago office, and Glespen had been supervisor of catalyst products at the company's headquarters in New York. F. E. Eck will replace Farlow in Chicago.

▸ **E. Rowland English** has joined Pipe Protection Service, Inc., Elizabeth, New Jersey, as vice president. He will be in charge of sales and will also serve as assistant general manager. Pipe Protection operates coating and wrapping plants at Elizabethport, New Jersey, Lowell, Massachusetts, and at customers' job sites. English was formerly eastern division manager for H. C. Price Company, Somastic Division.

▸ **E. S. McRoberts,** formerly assistant chief engineer of The J. B. Beaird Company of Shreveport, Louisiana, has been appointed manager of compressor sales of that company. For the past six years, McRoberts has been active in the design and development of the Beaird packaged compressor plant, which is widely used in gas conservation and oil production. He has been with the Beaird company since 1944. Prior to that time he was associated with Frick-Reed Supply of Tulsa, Oklahoma.

E. S. McRoberts

DEATH

▸ **Ben N. Youngken,** retired sales manager of the California Division, The National Supply Company, died at his home in Los Angeles, California, October 1. A member of the Petroleum Pioneers, Youngken, known as one of the most popular men in the oil fields of Southern California, retired November 1, 1942, after 43 years with National Supply.

Joining the Union Tool Company in 1897, he held responsible positions such as superintendent of field operations, sales manager and assistant to the president, until consolidation with National Supply. In 1922 Youngken became sales manager of the California Division of the latter company, a position he held until his retirement in 1942.

Savings that Pay Off...

ROPER ROTARY PUMPS *are quick to Service*

Above view shows how Roper Pumps are designed for easy accessibility. Not necessary to disturb pipe connections or mountings.

When an installation requires inspection because some destructive foreign element causes trouble, quick servicing design cuts down-time to a minimum and speeds the job. Furthermore, Roper replacement parts are interchangeable and available on all current models.

The exploded view above shows the detail of disassembly of a Roper Series F Pump . . . available for pressures up to 300 P.S.I. — built in 13 sizes up to 300 G.P.M.

Write for Catalog Today
Capacities to 300 g.p.m.
Pressures to 1000 p.s.i.
GEO. D. ROPER CORP.
732 Blackhawk Park Avenue
ROCKFORD, ILLINOIS

ROPER *Rotary Pumps*

Well Flooding

PUMPING STATIONS
REFINERIES

Layne built well water supply units of extra heavy capacity offer a quick, efficient and modern method of well flooding to increase oil recovery. Installations in single or multiple units are easily controlled for normal or pressure flooding. Layne also makes installations for pipeline pumping stations, cooling and general purpose water for refineries, office air conditioning, fire protection and employee housing needs. All installations are made by Layne's own field crews. Complete information, catalogs, bulletins, etc., will be sent on request. Address

LAYNE & BOWLER, INC.
General Offices, Memphis 8, Tenn.

Layne **WATER SUPPLY**
WELLS & PUMPS

X A.P.I. COUPLINGS FOR OIL FIELD USE

EVERY SIZE AND TYPE FROM *ONE* SOURCE

LINE PIPE COUPLINGS A.P.I.
⅛" to 12"—Seamless and Special Processed—Black or Galvanized

PLAIN TUBING COUPLINGS A.P.I.
1" to 3"—Seamless

EXTERNAL UPSET TUBING COUPLINGS A.P.I.
¾" to 3½"—Seamless

CASING COUPLINGS A.P.I.
4½" to 13⅜"—Long or Short

HYDRAULIC COUPLINGS
⅛" to 3"—Seamless

REAMED AND DRIFTED A.I.S.I.
¾" to 12"—Seamless or Spl. Processed

DRIVE PIPE COUPLINGS
⅜" to 12"—Seamless or Spl. Processed

Consult Our Nearest Quick Service Sales Office:

Albany, N. Y.—Albert L. Becker, 434 Clinton Ave.
Baltimore—Ted Barto, 2301 N. Charles St.
Boston—Wm. F. Bennett, 24 Spring St., Somerville
Buffalo—W. E. Spencer & Assoc's, 241 S. Elmwood Ave.
Chicago—Harry A. Jay, 122 So. Michigan Ave.
Denver—Earl H. Jones & Co., 1863 Wazee St.
Detroit—Thomas L. Osberger, 19451 Livernois Ave.
Erie, Pa.—R. J. Maggi, Box 711
Houston—Henry H. Paris Distributor, Inc., Box 932
Kansas City, Mo.—Wm. J. Hebenstreit, 3122 Coleman Rd.
Los Angeles—James A. Riordan Co., 1400 Santa Fe Ave.
Minneapolis—Lin J. Krause, 200 Lumber Exchange
Newark, N.J.—Murray Eskin, Industrial Office Bldg.
New York—Henry Stein, 50 Cliff St.
Philadelphia—J. W. Worthington, 401 N. Broad St.
Portland, Ore.—Earl H. Jones & Co., 1233 NW 12th Ave.
Richmond, Va.—P. C. Abbott & Co., Mutual Bldg.
San Francisco—Earl H. Jones & Co., 1150 Folsom St.
Seattle—Earl H. Jones & Co., 619 Second Ave.

FACTORY 'PHONE: WOODSDALE 3296

WHEELING MACHINE PRODUCTS COMPANY

ELM GROVE STATION **WHEELING, W. VA.**

R. D. Hood

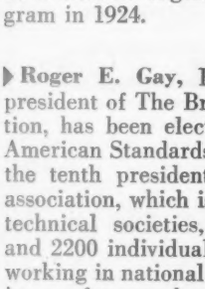
R. D. Hood has been promoted to the position of manager of Canadian operations of the Hughes Tool Service Limited, with headquarters at 7515 104th Street, Edmonton, Alberta. Hood has served in several capacities with the Hughes Tool Company in the United States since 1934, having recently moved to Canada from Oklahoma City. He has made periodic trips to Canada since 1949 in connection with the company.

C. Howard Black of Fairfield, Connecticut, has been appointed general manager of the General Electric Company's meter and instrument department at Lynn, Massachusetts. Black, formerly manager of engineering for the G-E construction material division, Bridgeport, Connecticut, succeeds **Harold E. Strang**, who previously had been named to his new post.

Black was graduated from Johns Hopkins University with a bachelor's degree in electrical engineering. He joined G.E. in Schenectady, New York, as a student engineer on the test program in 1924.

Roger E. Gay, Bristol, Connecticut, president of The Bristol Brass Corporation, has been elected president of the American Standards Association. Gay is the tenth president of the 33-year-old association, which is a federation of 110 technical societies, trade associations, and 2200 individual company members, working in national industrial, engineering, safety, and consumer standards. **Edward T. Gushee**, vice president, the Detroit Edison Company, Detroit, was elected vice-president of the association.

W. G. Turner, former regional manager, Cummins southeastern region, with headquarters at Atlanta, Georgia, has been transferred to Cleveland as regional manager, Cummins Great Lakes region. This transfer in the Cummins regional organization is announced by L. W. Beck, vice president — sales, Cummins Engine Company, Inc., Columbus, Indiana. Turner was appointed regional manager of the southeastern region in March, 1948. Previously, he served as assistant regional manager for the Cummins eastern region, headquarters offices for which are in New York City. He joined the Cummins sales force in June, 1947, after prior experience in the sales department of Marion Power Shovel Company, Marion, Ohio.



W. G. Turner

Louis P. Smith has been named manager of Morse Chain Company's Ithaca plant. Morse Chain is a subsidiary of Borg-Warner Corporation. Smith formerly was vice president in charge of manufacturing of the French and Hecht Division of Kelsey-Hayes Wheel at Davenport, Iowa. Prior to joining Morse Chain, he was employed by the Deepfreeze Appliance Division of Motor Products Corporation.

Smith is widely known in the mechanical and industrial engineering fields. During 13 years with Chrysler Corporation at the beginning of his industrial career, he rose to become master mechanic, factory manager, then supervisor of central estimating. He was educated at the University of Toledo.

G. G. Gibbs

J. G. Henderson

Jack G. Henderson has been added to the Odessa, Texas, staff of Technical Oil Tool Corporation, Ltd., as a service engineer. He will work under the direction of **F. E. Sievers. G. G. "Bud" Gibbs** will service the North Texas area, covering Wichita Falls, Nocona, and Graham, assisting R. K. Palmer. Gibbs is also a service engineer.

H. F. Robertson has been appointed comptroller of Quaker Rubber Corporation, division of H. K. Porter Company, Inc., Philadelphia, Pennsylvania. Robertson will be in complete charge of all accounting and auditing for the company. He has been with Porter for the past two years assisting the treasurer. Prior to this he spent six years in public accounting. Robertson is a Certified Public Accountant in the state of Pennsylvania and a graduate of Indiana State Teachers College.

Alfred H. Drewes was elected vice president of National Lead Company. He became a member of the board of directors and the executive committee in October of last year. Assistant to the president of the company since 1947 and director of Baker Castor Oil Company and Titanium Metals Corporation of America, Drewes joined the company 16 years ago.

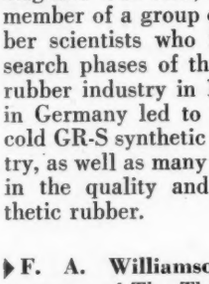
Joseph J. Morsman, Jr., was named treasurer of the company, succeeding Charles Simon, whose retirement was announced. Morsman joined National Lead in 1935 and was made assistant treasurer in 1941. In 1946 he was appointed assistant comptroller, retaining both positions until the present appointment. Simon has had 47 years of company service. He continues as a director.

Edward A. Jamison, a pioneer in the engineering and sales of liquefied petroleum gas, has joined the general sales department of the Gulf Oil Corporation. He will be situated in the company's general offices in Pittsburgh, Pennsylvania. Jamison received a B.S. degree in mechanical engineering from Purdue University in 1925. Prior to joining Gulf, Jamison was associated with the Phillips Petroleum Company for 23 years in the L.P. gas sales and engineering field. He has had wide experience in the sales and application of these products in the industrial and utility fields.

E. A. Jamison

George R. Vila, general sales manager of the Naugatuck Chemical division, United States Rubber Company, has been honored by the U. S. Army for his services with the Technical Industrial Intelligence Committee of the Joint Chiefs of Staff during World War II. Vila received a certificate of appreciation from Major General C. G. Helmick, commanding general of the New England Sub-area, for his work as a member of a group of six top flight rubber scientists who investigated the research phases of the German synthetic rubber industry in 1945. Their findings in Germany led to the development of cold GR-S synthetic rubber in this country, as well as many other improvements in the quality and versatility of synthetic rubber.

F. A. Williamson, Midwest sales manager of The Thew Shovel Company has announced opening of new offices in Room 230 Forsythe Plaza Building, 8135 Forsythe Boulevard, Clayton, Missouri. His offices were formerly at Room 607, Continental Building, 3615 Olive Street, St. Louis, Missouri. New telephone number is CAbany 5575.



T. F. Griffin

Thomas F. Griffin has been named Holyoke works purchasing agent for Worthington Pump and Machinery Corporation, succeeding Milton Roberts who has resigned to engage in another business. Griffin graduated from Walter Hervey Junior College, and has been with Worthington for the last 10 years. He has served as assistant in the general purchasing department, and has served as general buyer since 1950. **LeRoy D. White**, coordinator of the corporation's contract engineer division, has been named general buyer succeeding Griffin. White has been with Worthington Pump and Machinery Corporation eight years.

W. H. Cook

W. H. "Windy" Cook has been appointed Gulf Coast division manager for the Eastman Oil Well Survey Company at Houston, Texas. Cook has been associated with Eastman since 1938, and was formerly Gulf Coast division sales manager. He is a graduate of Rice Institute. **J. C. "Hap" Staton,** who has been associated with the company's Gulf Coast Division for the past 10 years, will continue in his present position as general field superintendent.

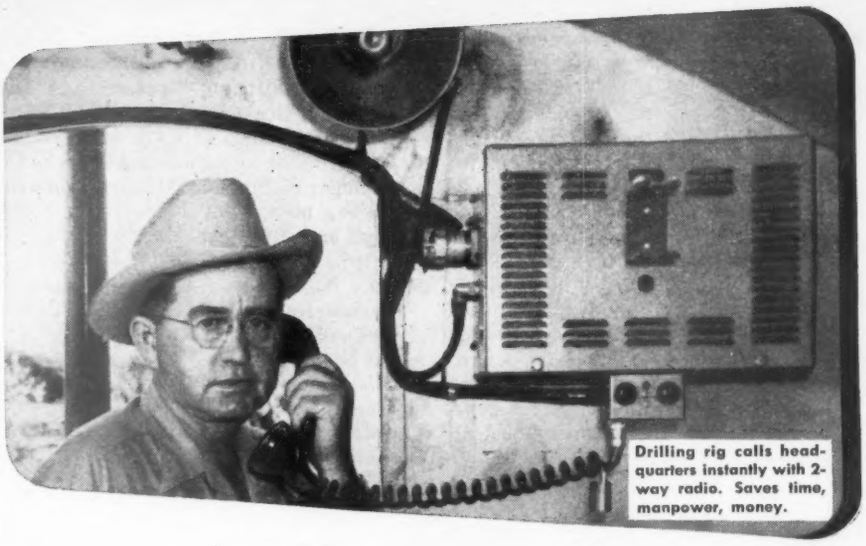
Douglass Taber, a graduate of Brown University, has joined the B-I-F Industries (Builders-Providence, Inc.; %Proportioneers, Inc.%; and Omega Machine Company) as manager of the Pittsburgh office. Since 1936, Taber has been associated with Greeley and Hansen consulting engineers of Chicago. **Alden Carpenter,** a graduate of the University of Minnesota and formerly with Hitchcock and Estabrook, consulting engineers of Minneapolis, will be in charge of the Minneapolis office at 221 Sexton Building. **Raymond McIndoe,** a graduate of Rice Institute, and formerly with the Pennsylvania Department of Health, has been appointed assistant manager of the standard and engineered products division of Builders-Providence, Inc.

James H. Burtis has been named sales engineer, four-cycle engine department, heavy machinery division, Nordberg Manufacturing Company.

Burtis received a degree in electrical engineering from Columbia University in 1925. Following his graduation, he was employed in New York City by the Consolidated Edison Company and in 1929 joined the New York Central Railroad as an electrical engineer. In 1950, he transferred to the Chicago procurement office of the U. S. Army Corps of Engineers where he was employed as an industrial engineer assisting in the purchase of diesel-powered equipment, where he remained until joining Nordberg.

R. H. McLemore

Robert H. McLemore of Welex Jet Services, Inc., Fort Worth, Texas, was elected to the post of executive vice president and general manager of the company. He formerly was vice president of operations. Before joining Welex in 1945 McLemore was district engineer for Sun Oil Company in Dallas. **Sterling Holloway,** Fort Worth, president of Continental Life Insurance Company, was elected as a new director of Welex.



"RCA 2-WAY RADIO Saves Us Thousands of Dollars Each Year"

says Lamar H. Moore, President, Moutray-Moore Drilling Company of Abilene, Texas

"We save money every day on our routine operations, but our biggest saving is when things go wrong at the rigs. This happens frequently. Broken mud lines, twist-offs, stuck drill pipe, equipment trouble . . . these are only a few. Fast communications can prevent what might otherwise be heavy losses, especially on fishing jobs. I don't know how we ever did business without 2-way radio. We are now operating 5 rigs and a fleet of cars within a 100-mile radius of Abilene, Texas. These units can contact our base station with its three remote operating points 24 hours a day."

Radio works "miracles" every day

Fast action is typical of RCA 2-way radio wherever it's applied. Puts a "phone" in every auto, truck, or rig. Saves time, manpower, money. Saves gas and oil, wear and tear. Keeps contact with field forces day and night. Speeds up whole operation.

Radio easy to install—operate—maintain

RCA helps you set up 2-way radio. And RCA Service Company handles service and installation if desired. Lightweight, compact mobile unit can be installed in only 4 hours. Easily maintained, uses standard tubes. Exceeds FCC requirements. Central transmitter serves any number of mobile units within service area. Designed and backed by RCA, world leader in radio. See how radio can save *you* money. For full story, mail coupon TODAY!

Dept. 127X, RCA Engineering Products, Camden, N. J.
Please send my FREE copy of illustrated booklet "RCA 2-Way Radio for Industry."

Name_____ Title_____

Company_____

Address_____ City_____ State_____

RCA RADIO CORPORATION of AMERICA

To obtain more information on products advertised see page E-51

J. R. (Jim) Coffing has been named vice president in charge of sales, advertising, and general office administration, Coffing Hoist Company, Danville, Illinois. Coffing was first associated with the company when at the age of 12 he started in as clean-up boy. He worked his way up through the various departments of production and administration to become general sales manager prior to World War II. He attended the University of Alabama.

J. R. Coffing

Walter J. Andree, director of merchandising of Morey, Humm and Johnstone Advertising Agency, has been elected a vice president. Andree joined the organization in 1949 after ringing up a 30-year record as sales promotion manager of Sinclair Refining Company. He is a member of the Sales Executives Club and American Marketing.

Lu N. Tidd has been named manager of contract sales for the Oklahoma City plant of Black, Sivalls and Bryson. He has been an officer of the company since 1950, in the capacity of assistant treasurer and assistant secretary. Before his present appointment Tidd was general credit manager for five years.

Manufacturers of Special Millwork

Distributors of Johns-Manville Building Materials

Curtis Woodwork

When it is necessary to move from an old lease don't leave your investment in housing behind. Leave no ghost town of crumbling houses and buildings.

Use STURDYBILT Prefabricated, *Movable* houses. Then you can take your investment in housing with you to an active location.

Investigate STURDYBILT Prefabricated buildings before you buy *any* oil field housing.

STURDYBILT PREFABRICATED, DEMOUNTABLE HOUSES

SOUTHERN MILL & MANUFACTURING CO. • TULSA, OKLAHOMA

STURDYBILT HOUSES COMPLY WITH COMMERCIAL STANDARD CS125 OF THE NATIONAL BUREAU OF STANDARDS FOR PREFABRICATED HOMES

B. L. Pearce

R. T. Sweeney

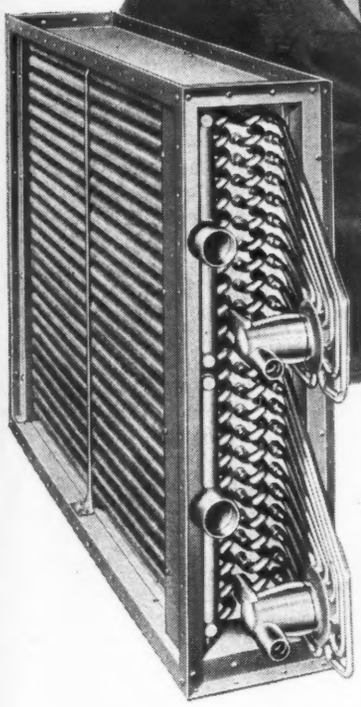
Bert L. Pearce has been appointed chief engineer of the Ewart plant in Indianapolis, to succeed **Charles R. Weiss,** who has retired after 42 years' service at Link-Belt Company's Philadelphia and Indianapolis plants. **Russell T. Sweeney** has been appointed assistant chief engineer. Pearce, a graduate from Rose Polytechnic Institute, joined Link-Belt at the Dodge plant, Indianapolis, in 1936. He was assistant chief engineer for product design before his recent appointment. Sweeney, the new assistant chief engineer, joined Link-Belt, at the company's Dodge plant in 1918 as a tool designer, later becoming chief draftsman. Last January he was appointed assistant chief engineer for application engineering.

Joseph L. Kiraly has been named assistant to the vice president in charge of production for American Meter Company. A graduate of Fenn College, Kiraly was formerly with Stevenson, Jordan, and Harrison, management consultants for 9 years, as an industrial engineer.

Robert P. Bremner has been appointed assistant to the vice president in charge of operations for The Youngstown Sheet and Tube Company. Bremner came to Youngstown late in 1947 as a member of the raw materials department. Eight months later he was appointed mining engineer to deal with all the company's mining problems.

Edward D. Van Fossen has been appointed to Cooper-Bessemer's regional field office in Seattle, Washington. Working directly under Robert C. Jones, Cooper-Bessemer branch manager, Van Fossen will concentrate his efforts in furthering Cooper-Bessemer's engineering service to users of heavy internal combustion engines, pumps and compressors in the northwest sector of this country. Van Fossen graduated in mechanical engineering from the University of Washington and has been with Cooper-Bessemer three years.

E. D. Van Fossen



ASK THE AEROFIN MAN

For the Practical Answer to Your Heat-Exchange Problem . . .

There is a competent Aerofin heat-transfer engineer near you, qualified by intensive training and long experience to find the *right* answer to your own particular heat-exchange problem.

This specialized knowledge is there, ready for you to use to your greatest advantage. Ask the Aerofin man — and be right.

Aerofin is sold only by manufacturers of nationally advertised fan system apparatus. List on request.

AEROFIN CORPORATION

410 South Geddes St., Syracuse 1, N. Y.

J. H. Roach, formerly in the Tulsa district sales office for The Babcock and Wilcox Tube Company, was transferred to the Houston office and named assistant sales manager. **W. C. Mohrman,** formerly stationed at the Houston office, was transferred to the Tulsa office and named a district salesman. Roach is a native of Houston and has been with the Tube Company since 1939. He was stationed at the company's sales offices in Houston and Chicago prior to his service at Tulsa where he had been assistant district sales manager since 1946. Mohrman is a graduate of Rice Institute and has been with B&W at Houston since 1946. Announcement of the personnel changes was made by W. J. Thomas, general sales manager.

William Irrgang was elected executive vice president of The Lincoln Electric Company. He joined Lincoln in 1929 and for the past 23 years has been engaged in various phases of plant operation. As a methods engineer, he developed manufacturing methods and machinery for reducing the cost of welding electrodes that established Lincoln's position of dominance in this field. Irrgang was born in Germany and is a graduate electrical engineer from the State Technical School in Cologne.

William Irrgang

Walter Forbes, associated with the Long Beach branch of Ken Corporation for the past year has been placed in charge of sales and service in the Rocky Mountain area, working in coordination with Mud Control Laboratories, 150 E. Midwest Street, Casper, Wyoming. **Jay Waldren** has recently joined the sales and service division of Ken Corporation and will work at the Long Beach offices. **William Rodgers,** formerly with Mud Control in Oklahoma City, has joined the Ken Corporation in charge of sales and service in the Mid-Continent area. His offices will be at 1832 West Reno Street, Oklahoma City. Prior to his appointment he was stationed at the Long Beach plant.

John A. Rozos has been appointed director of Dodge Manufacturing Corporation, Mishawaka, Indiana. He has been identified with export sales of prominent American Manufacturers since 1929, except for a period of military service during World War II. He served 4½ years as a first lieutenant with the U. S. Army Signal Corps.

J. A. Rozos

Howard M. Daschbach has been appointed general traffic manager of Consolidated Western Steel Corporation, a United States Steel subsidiary, which has headquarters in Los Angeles. Daschbach will continue as general traffic manager of two other U. S. Steel subsidiaries, Columbia Steel Company, which has headquarters in San Francisco, and Geneva Steel Company of Utah. He will continue to maintain his headquarters at San Francisco.

Tom Haley has been promoted to sales manager at Master Tank and Welding, Dallas, Texas. Haley has been with the company from its beginning. Prior to this period he was sales manager of Master Petroleum Company. He attended North Texas Agricultural College. **C. A. McGee** has been promoted to the position of office manager.

Tom Haley

Russell H. Bullied has been promoted to division accountant for National Supply Company's Canadian division. His headquarters are at Calgary, Alberta, in the office recently opened to handle all Canadian sales accounting functions and thereby facilitate customer transactions. Employed as a clerk in the credit department at Calgary, Bullied was transferred to the position of pricer in 1951, a position he held until his present promotion to division accountant.

Safe and Sure Packing for

HOT OIL CHARGE PUMPS

....ends packing blowouts and hot oil flashes

"JOHN CRANE"

High Temperature

METALLIC PACKING

"John Crane" High Temperature Metallic Packings have been developed, as a result of years of extensive research, to withstand temperatures as high as 750°F—discharge pressures of over 800 lbs.—speeds of 3600 rpm or more.

These "John Crane" Packings have been in continuous use on heavy and light hot oil charge pumps for years without maintenance or attention. One user reports..."seven years of continuous service and still as dependable as the day it was installed".

For a truly dependable packing for hot oil charge pumps, specify "John Crane" Style 101-AL. For the *right* combination of "John Crane" Packings to meet your specific needs, consult with experienced Crane Packing Company field engineers.

STYLE 101-AL (Aluminum)

Available in spirals and die-formed rings to specific stuffing box sizes.

Made of continuous thin ribbons of soft aluminum foil, spirally wrapped, crinkled and folded about a small core of pure dry asbestos roving, and squared to desired size.

ADVANTAGES... Minimum wear on shaft sleeves... Easy adjustment by gland takeup... Operation at highest temperatures ... Easy cutting of rings from stock spirals.

SERVICE... High temperature centrifugal hot oil charge pumps... hot oil valves... Diphenyl valves...still necks.

SEND FOR CATALOG DEPT. PE12, 1843 CUYLER AVENUE, CHICAGO 13, ILL.

JOHN CRANE

PACKINGS AND MECHANICAL SEALS

CRANE PACKING COMPANY

CHICAGO

Offices in All Principal Cities in United States and Canada

R. A. D'Amour

G. W. Plondke

R. A. D'Amour has been appointed assistant regional manager, Washington, D. C. region of Cummins Engine Company, Inc. **John W. Post** is regional manager of the Washington, D. C. region. **G. W. Plondke** has been appointed Cummins' assistant regional manager, central region, and **Fred W. Hartmann** is regional manager of the central region, with offices in Chicago.

D'Amour joined Cummins in 1948 and was made a sales engineer in 1949. He graduated from Michigan College of Mining and Technology. Plondke graduated from George Washington University, Washington, D. C., in 1948, and became affiliated with Cummins at that time.

Thomas D. Jolly, vice president in charge of engineering and purchases for Aluminum Company of America, has received Carnegie Institute of Technology's Merit Award for "worthy achievement." A graduate of Tech's Class of 1913, Jolly was one of 16 alumni members honored for "distinguished service and accomplishments" at Carnegie's Homecoming Luncheon held in Pittsburgh recently. In 1946, Jolly was chosen "Man of the Year" by Tech's Alumni Federation.

Adger S. Johnson has been appointed president of National Carbon Company, a division of Union Carbide and Carbon Corporation. He has been vice president and general manager of National Carbon since 1950. Johnson attended Virginia Polytechnic Institute, which awarded him a degree in chemical engineering in 1928. Upon graduation he entered the employ of National Carbon Company, and in 1933 was assigned to the Eveready battery plant in Shanghai, China. He later returned to the U. S. and became vice president and general manager in 1950.

A. S. Johnson

Howard R. Godfrey, Jr., for the last 18 months an assistant engineer in Allis-Chalmers centrifugal pump department, has been assigned to the chemical and petroleum section of the company's New York district office. Godfrey is a mechanical engineering graduate of Oregon State College and has been with Allis-Chalmers since 1948.

P. H. Batten was re-elected chairman of the board of Twin Disc Clutch Company, Racine, Wisconsin, at a recent meeting of the board of directors. Others re-elected were **John H. Batten,** president; **Soren Sorenson,** vice president, manufacturing; **N. F. Adamson,** vice president, sales.

G. L. Shuman was named vice president, finance, and secretary. Secretary-treasurer of the company since 1943, Shuman joined the company in 1928.

R. G. DeLong was elected vice president, hydraulic division. DeLong had been manager, hydraulic division, since 1945, and first joined Twin Disc in 1939. **R. T. Howell** was named treasurer-assistant secretary. Howell became affiliated with Twin Disc in mid-1940 and was named assistant secretary in 1942. **R. T. Rehwald** was appointed assistant secretary - comptroller, hydraulic division. Rehwald had been assistant secretary of the hydraulic division since 1942. **W. F. Shurts** became director of engineering. Shurts, who joined the company in 1940, had been chief engineer, hydraulic division, since 1942.

Gale Carroll has been added to the Taylor Forge and Pipe Works' Houston district sales office.

A resident of Texas for the past 15 years, Carroll formerly served as sales and advertising manager for Tube-Kote, Inc. He attended Hastings College and the University of Nebraska, and is a member of Nomands, API, and NACE.

Bill Whitmire has been added to the Regan Forge and Engineering Company staff as a sales engineer. He will have his headquarters in Bakersfield, California. A graduate of the University of California, Whitmire was employed with Gulf as a field engineer for the Gulf Coast division of Stanolind Oil and Gas Company. He was more recently employed by Camco, Inc., Houston, Texas.

Bill Whitmire

Harry H. Fair of San Francisco was elected chairman of the board of directors of Caterpillar Tractor Company at a recent meeting of the board in San Francisco. He succeeds C. L. Best, who died in San Francisco recently. Elected to the board to replace Best was **A. H. Brawner,** president of W. P. Fuller and Company, San Francisco, oldest and largest Pacific Coast glass and wallpaper firm. Fair's connection with the tractor business dates back to 1918 when he became a stockholder and director of Best Tractor Company one of the constituents of Caterpillar Tractor. A graduate of Princeton University, 1921, Brawner began his work with W. P. Fuller and Company the following year. He became president of the firm in January 1946.

Dependability Begins HERE

This Starter is WISCONSIN-POWERED!

Huge engines are powerless unless the starter engine delivers starting power when you need it . . . the kind delivered by this Wisconsin Heavy-Duty Air-Cooled Engine.

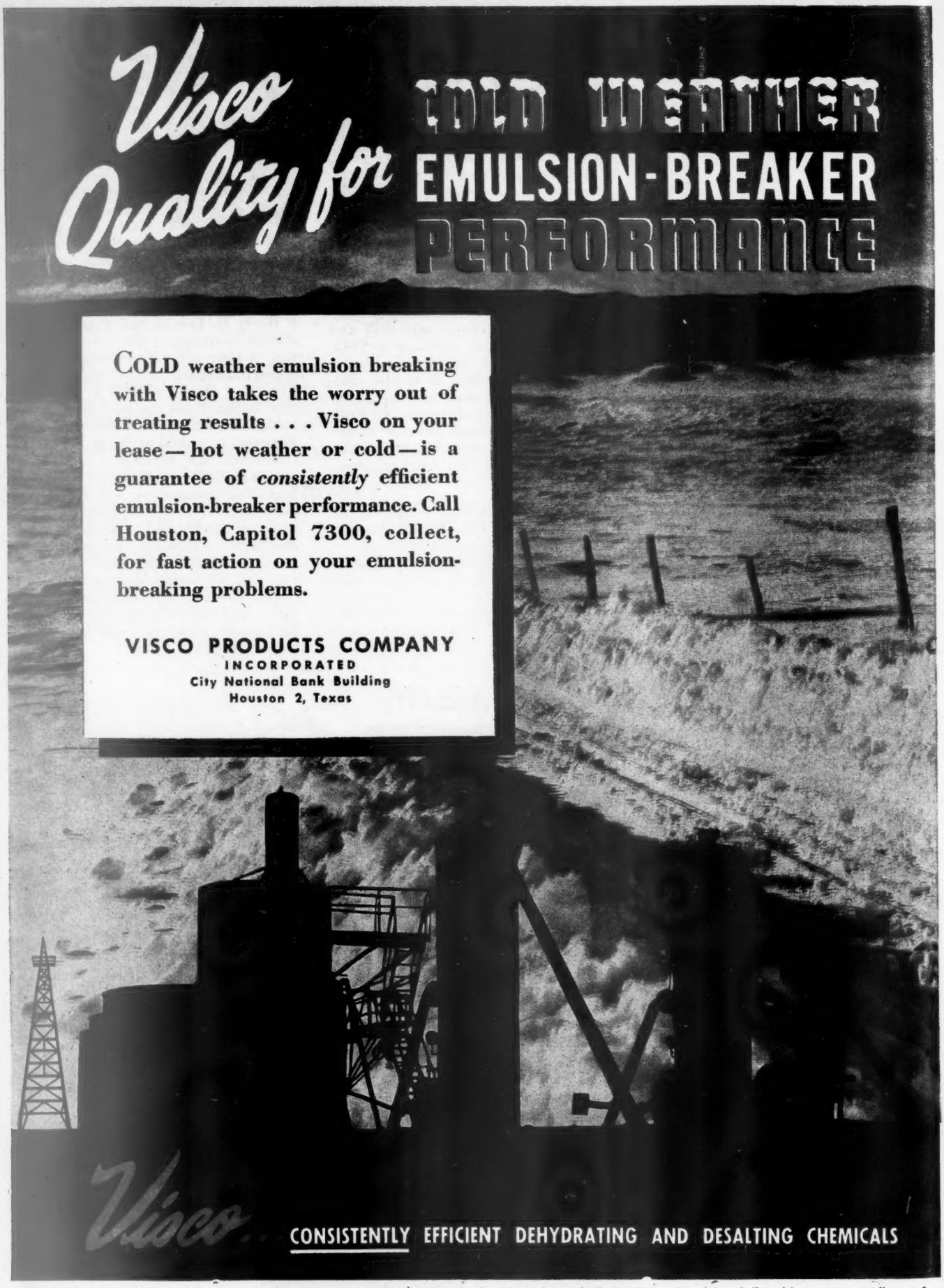
Oil field operators everywhere endorse the "big engine dependability" of Wisconsin Engines in 3 to 30 horsepower units. For example, a Wisconsin starts fast in any-weather . . . then runs steadily due to an easily-serviced OUTSIDE magneto with impulse coupling. And you mount drive pulleys directly on extended crankshaft because of tapered roller bearings at both ends of the shaft. Also, your engine cools by air alone . . . no summer overheating or winter freeze-ups. And rugged construction, top to bottom, assures you of the Most Horsepower Hours of On-The-Job Service *always*.

4-cycle single-cylinder, 2-cylinder and V-type 4-cylinder models, 3 to 30 hp.

WISCONSIN MOTOR Corporation
MILWAUKEE 46, WISCONSIN
World's Largest Builders of Heavy-Duty Air-Cooled Engines

WRITE TO HARLEY SALES CO.
619 S. MAIN STREET, TULSA, OKLAHOMA
M & M BUILDING, HOUSTON, TEXAS
505 SOUTH MAIN ST., WICHITA, KANSAS
OIL FIELD DISTRIBUTORS FOR WISCONSIN ENGINES AND ALL TYPES OF UTILITY UNITS.

Visco Quality for COLD WEATHER EMULSION-BREAKER PERFORMANCE



COLD weather emulsion breaking with Visco takes the worry out of treating results . . . Visco on your lease — hot weather or cold — is a guarantee of *consistently* efficient emulsion-breaker performance. Call Houston, Capitol 7300, collect, for fast action on your emulsion-breaking problems.

VISCO PRODUCTS COMPANY
INCORPORATED
City National Bank Building
Houston 2, Texas

Visco... CONSISTENTLY EFFICIENT DEHYDRATING AND DESALTING CHEMICALS

NOTICE: Visco Products Company is authorized to manufacture and sell Visco Oil Treating Compounds for use in the breaking and resolving of oil emulsions, or to grant licenses for such use, under the following United States Letters Patent: 2,050,639; 2,050,640; 2,206,589; 2,214,783; 2,214,784; 2,225,189; 2,303,414; 2,307,813; 2,318,034; 2,318,035; 2,321,056; 2,335,554; 2,454,808; 2,514,389. Visco Products Company is willing to grant licenses on a royalty basis, to oil companies, and to others desiring to practice the patented subject matter, under any and all of the above Letters Patent, permitting the user to purchase the oil treating compounds at will from any vendor, or to prepare the compounds for use or to use the compounds under the above Letters Patent. Application for license should be made to: **Visco Products Company,** Houston, Texas.

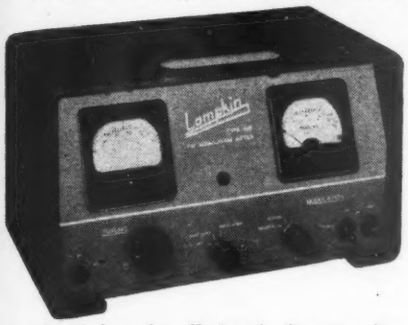
New Machinery and Supplies

Use reply card to procure promptly complete information and prices of products described here in brief.

Circle corresponding letter or letters on reply card.

(A) MODULATION METER

Lampkin Laboratories, Inc., has announced a new Type 205 FM modulation meter. The new unit measures the maximum deviation due to modulation, of fixed and mobile FM transmitters, as



required by the Federal Communications Commission. The type is 205, tunable to any number of transmitter frequencies as employed by public-safety, land-transportation, industrial, and other 2-way radio communications services. The meter indicates modulation swing only; it does not measure center frequency.

Circle letter (A) on reply card.

(B) AIR COMPRESSOR

Now available is the new standard model 365 air compressor, manufactured by The Jaeger Machine Company, featuring diesel power by Cummins. The new compressor, rated at 365 cu ft of air per minute at 100 psi pressure, utilizes a 165 hp Model HRBI-600 Cummins diesel, made by Cummins Engine Company for its power plant. Engine operating speed of the diesel-compressor unit is 1240 rpm. Both the diesel and compressor are mounted on structurally welded main frames. The wagon has an "autosteer" front axle, and can be hauled safely at 35 miles per hour.

Circle letter (B) on reply card.

(C) TURBINES

A 75 per cent increase in oil "thruput" has been achieved at the Standard Oil-Toledo Refinery, Toledo, Ohio, through the installation of a General Electric Type DP-16 mechanical drive turbine coupled to a centrifugal pump, it has been reported. The new turbine replaces a reciprocating steam-driven pump which had a capacity of 17,000 bbl per day, compared to the present capacity of 30,000 bbl per day. Although this increase is outstanding, the new G-E turbine also eliminates a severe problem of vibration, which existed with the old reciprocating steam pump. The decrease in vibration will insure longer life for other equipment throughout the unit, Sohio engineers state.

Circle letter (C) on reply card.

(D) TENSION PACKER

Guiberson Corporation has announced a new hold down packer, the type "WF", which is a tension packer designed for water-flooding, salt water disposal, and similar projects. It may also be used for injecting fluids under moderate pressures into the formation below the packer and for other operations requiring tubing pressures in excess of pressure in the annulus. Packing element on the "WF" is a long sleeve type with 16 in. of exposed soft rubber that will seal rough and pitted casing wall.

Circle letter (D) on reply card.

(E) OIL BASE MUD

Oil Base, Inc., manufacturers of Black Magic, introduces Econo Magic, a new oil base material that is mixed with crude oil for use in completing shallow, cold wells, for workovers, and for redrilling into depleted oil sands. Plastering properties are excellent; it deposits a paper-thin mud cake and is highly recommended where lost circulation in oil sands is a problem. It will not lose water with the filtrate under normal temperatures, but high temperatures and conditions requiring excellent weight material suspension ability are to be avoided.

Circle letter (E) on reply card.

(F) WELDING MACHINE

A new heavy duty direct current welding machine has been put on the market by the A. O. Smith Corporation. The machine is designed for all industrial uses, where D. C. welding is required. Extensive field testing has shown the new unit to be free of stack failure. This is accomplished by directing a high velocity downdraft of cool air over the rectifier stacks before passing this air through other parts of the machine. The blast is expelled at the base of the A. O. Smith welder. This not only assures proper cooling, but promotes internal machine cleanliness.

Circle letter (F) on reply card.

(G) BAND-PASS FILTER

Krohn-Hite Instrument Company has announced the Model 330-A low frequency band-pass filter. Both the high and low cut-off frequencies are independently adjustable from 0.02 to 2000 cps, providing maximum flexibility of adjustment of both the band center frequency and band width. The gain is unity in the pass band and drops to a rate of 24 db/octave outside the pass band. The peaking at the corner frequencies is held at such a value that the attenuation at these frequencies is maintained small, but no peaks greater than 1 db in the gain vs frequency plot are produced.

Circle letter (G) on reply card.

(H) METAL PRIMER

Prufcoat Laboratories, Inc., has announced the availability of a new heavy-duty metal primer. Designated as Prufcoat Primer P-50, it is claimed to be effective with either conventional paint or active-solvent top coats. It is to be used for both ferrous and non-ferrous metals. Ideal surface conditions are not necessary, the company states, as this versatile primer is designed to be completely effective on severely corroded metal surfaces so commonly found in process plants.

Circle letter (H) on reply card.

(I) MOTORPUMPS

Ingersoll-Rand Company announces a new line of self-priming motorpumps designed for the petroleum industry. These pumps are intended for pump-

ing applications under suction lift where the presence of air or vapor makes it impractical to use the conventional centrifugal pumps. These pumps are especially suited to bulk station purposes for pumping liquids.

Circle letter (I) on reply card.

(J) RECEIVER PURIFIER

A new receiver-type Purifier has been developed by the V. D. Anderson Company for removing destructive entrainment from vapor lines, according to an announcement by the company. Applications for this unit include (1) to protect turbines, steam engines by removing damaging slugs of entrainment (2) use in exhaust steam installations where it is necessary to remove oil and other undesirable entrainment and (3) removing condensate from compressed air systems.

Chief advantages claimed by the manufacturer for this receiver purifier, are no moving parts, a self-cleaning action that eliminates maintenance, and careful fluid dynamics designing.

Circle letter (J) on reply card.

(K) ROTARY PUMP

A heavy duty, vane type rotary pump has been added to the existing line of rotary pumps manufactured by Worthington Pump and Machinery Corporation, Harrison, New Jersey. All models are positive displacement, sliding vane type in which the pressure of the liquid being pumped maintains contact with the vanes against the liner. The pumps are to be manufactured in both internal and external bearing design; the external bearing models being especially suited for non-lubricating liquids such as gasoline and kerosine.

Circle letter (K) on reply card.

(L) AIR DIFFUSER

A new type of equipment for diffusing air or other gas into a liquid to produce agitation or to effect absorption has been announced by Infilco Inc. The Colaflex diffuser, as the equipment is called, is a flexible, collapsible diffuser that maintains practically constant permeability for fine diffusion of air or gas in sewage and industrial waste treatment, water conditioning, biological manufacturing processes, and absorption processes. The diffusing element is of fabric. Gas or air under pressure inflates the element to an erect, distended position and diffuses through the fabric to the liquid.

Circle letter (L) on reply card.

(M) CAVITY RECONATORS

Television interference caused by spurious and harmonic radiations of base station 2-way radio communications equipment can be eliminated by the addition of a Motorola precision selector cavity resonator, the company has announced. These units, now available from Motorola, minimize spurious and harmonic radiation from any transmitter antenna system and make it possible to use two or more transmitters on the same antenna without mutual interference. A cavity resonator is effectively a very high "Q" circuit which can be inserted into a line, connecting the transmitters and receivers with the antenna.

Circle letter (M) on reply card.

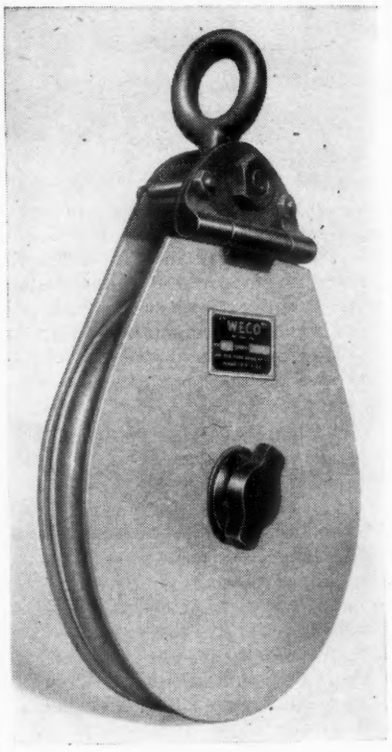
(N) OIL FILTERS

The Hilliard Corporation announces a new line of HILCO hyflow lubricating, fuel, and industrial oil filters, including swing-bolt head construction for quick opening of filter covers and a lifting device for ease of handling. They are available using both factory-made filter cartridges and the repackable type, which the operator repacks from a bulk supply of filtering material. Filtering materials are available for straight-run mineral oils or the heavy-duty detergent types. Units are available in capacities ranging from ½ gpm up to 1000 gpm for bypass filtering of diesel and gas engine lubricating oil and fuel oil.

Circle letter (N) on reply card.

(O) LINE BLOCK

Well Equipment Manufacturing Corporation has recently announced a larger and stronger tong line block for handling the heavier tongs being used today. The 12-in. sheave provides the extra diameter needed to reduce the



bend in the tong line and assure faster, easier, smoother handling of the tongs. Employing the WECO patented drop side, the block is of extra heavy construction throughout. The sides are heavy steel plate and the sheave is malleable iron with webb design to minimize weight without sacrificing strength. The machined groove has no rough edges to cut the line. The sheave is equipped with a needle bearing for smoother running. Other features of the new 12-in. Weco tong line block are its forged steel swivel eye; precision clearance between sheave and side plates to prevent the line from wedging between them, and many others.

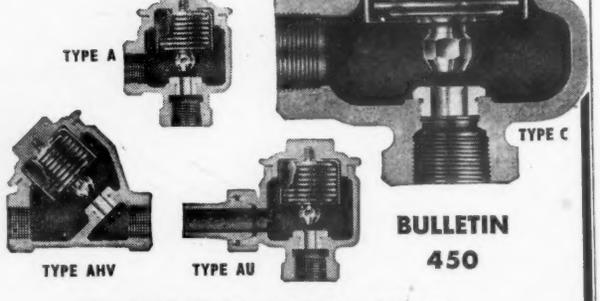
Circle letter (O) on reply card.

NICHOLSON MAKES

Freeze-Proof Steam Traps

for Every Plant Use

Because they drain completely when cold, these four types of Nicholson steam traps are positively freeze-proof. Can be freely installed outdoors. Universally recommended for use in lines which need not be in continuous use during cold weather, because they are freeze-proof and because their 2 to 6 times average drainage capacity results in minimum heat-up time. The non-air-binding feature of Nicholson traps also notably facilitates heat transfer in severe weather. Sizes ¼" to 2"; pressures to 225 lbs.



BULLETIN 450

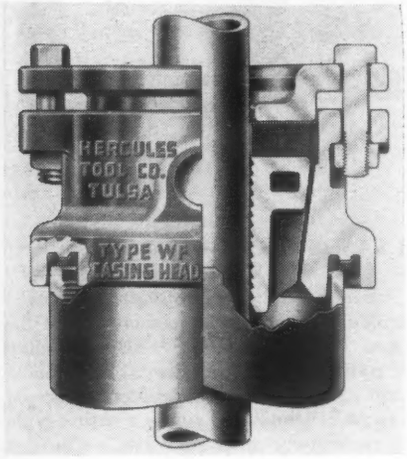
217 OREGON ST., WILKES-BARRE, PA.

W. H. NICHOLSON & CO.

TRAPS · VALVES · FLOATS

(P) NEW 'WF' TUBING HEAD

The Hercules Tool Company has announced a new type "WF" tubing head and/or casing head designed especially for water-flooding projects. It can also be used on other wells and is capable of



supporting an inner string of pipe weighing up to 100,000 lb. Because of its special design features it can be used for non or very low pressure wells where it is desired only to pack off the well head to prevent surface water or other elements from getting down into the well and where a more expensive well head is not required. A special groove extending up into the bottom of the "WF" head is equipped with packing that provides a seal between the head and casing.

Circle letter (P) on reply card.

(Q) PERLITE PRODUCTS

Now available is the industrial perlite products which have wide application in the chemical industry. The products sold under the brand name of Grellex are completely inorganic, are insoluble in water and most acids and contain no oxidizing elements, the manufacturer reports. They have extremely low electrical conductivity and vapor absorption. Specific heat is approximately 0.20 Btu/lb/°F. Thermal conductivity ("K") factors vary with the size gradation, density, and mean temperature, ranging from .22 to .35 Btu/sq ft/hr/°F/in. thick. Perlite is a form of volcanic rock, which when heated quickly to a suitable point in its softening range, expands to form a lightweight, non-combustible, glass-like material of cellular structure. Great Lakes Carbon Corporation, Perlite Division.

Circle letter (Q) on reply card.

(R) ADSORPTION CELLS

Beckman Instruments, Inc., has perfected a method of producing matched 10 mm Pyrex absorption cells for its Model B and Model DU Spectrophotometers so that these cells can be mass-produced at a new low price for equipment of this quality. These new Beckman Pyrex cells feature optically-polished outer surfaces. All cells in a single shipment are matched within 3 per cent transmission at 320 millimicrons and and the light path length of each individual cell is held to an accuracy of ± 0.025 mm. They have a light path of 10 mm, an OD of 12 mm, are 46 mm high, and are supplied complete with covers. They are recommended for all applications in the range of 320 to 1000 millimicrons where the critical matching tolerance of the Corex type cells is not required.

Circle letter (R) on reply card.

(S) CHEMICAL THINNER

A specially-compounded chemical thinner for clay-water muds or clay-water-oil emulsion muds formulated for the express purpose of replacing quebracho is now being maufactured and marketed by Macco Corporation Drilling Fluid Division under the trade name of "Maccotan". The product provides low cost thinning, may be used pound for pound in place of quebracho, and requires less caustic soda than the latter. Furthermore, Maccotan may be used in conjunction with a complex phosphate without caustic soda for most applications. Maccotan is a dry non-hygroscopic powder packaged in strong 4-ply paper bags containing 50 lb net weight.

Circle letter (S) on reply card.

(T) AMPLIFIER CONTROL

Engineers look over the new Regutron magnetic amplifier control.

Electric Machinery Manufacturing Company has announced development of a new Regutron magnetic amplifier control. This new controller is used with the E-M adjustable-speed magnetic drive, an electromagnetic torque transmitting device, which gives variable speed output when used in combination with a constant speed motor. This magnetic amplifier control eliminates all the complicated electronic circuits of the previous electronic type amplifiers. A simple saturable core reactor amplifier system using non-moving parts accomplishes the precise, stepless control of speed to within ±0.5 per cent of speed called for. This hairline sensitivity is obtained through a current amplification ratio of approximately 20,000 to 1.

Circle letter (T) on reply card.

Get Truscale For Accurate Liquid Level Indication Down Where You Can See It

Get This New Catalog of JERGUSON TRUSCALE REMOTE READING GAGES

JERGUSON Truscale Gages are virtually indispensable protection for boilers, storage tanks and processing equipment. A single error in reading liquid level can prove very expensive. Jerguson Truscale Gages forestall errors by bringing the reading down to eye level where your operator can see it and properly protect your equipment.

Amazingly accurate, the Jerguson Truscale Gage records liquid level at remote points with accuracy as close as ½ of 1% of scale reading; has built-in adjustment for easy calibration for any specific gravity or W.S.P.; has standard ranges up to 100"; internal moving parts of stainless steel; visible and audible alarm systems; illuminated dial; scale markings and pointer that glow in the dark; and is available with auxiliary repeaters.

The new Jerguson catalog, profusely illustrated, tells in compact, easy-to-read form how Jerguson Truscale Gages operate . . . and why they are the best and the most dependable for your remote reading needs.

Send now for your copy of the new 8-page Jerguson Truscale Gage catalog. Write today.

JERGUSON

Gages and Valves for the Observation of Liquids and Levels

JERGUSON GAGE & VALVE COMPANY
100 Fellsway, Somerville 45, Mass.
Representatives in Major Cities
Phone Listed Under JERGUSON
In Europe: Bailey Meters & Controls, Ltd.

(U) SUBMERSIBLE PUMP

The BJ "Subette" pump is a small submersible pump designed for small capacities at high heads from wells of 6-in. inside diameter or larger. This pump has a capacity range of from 30 to 130 gpm at heads of from 80 to 770 ft. The motors, available in sizes of 5, 7½, 10, and 15 hp, are 3-phase, 60 cycle, 2-pole, 220/440 volt and have a speed of 3500 rpm. A 50-cycle motor is available at a speed of 2900 rpm. All motors are oil-filled, mechanically-sealed, and capable of operating completely submerged in water.

Circle letter (U) on reply card.

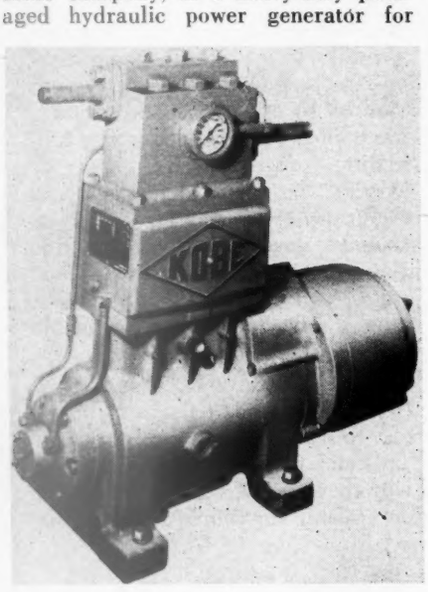
(V) IMPACTOR HANDLE

Edward Valves, Inc., has announced development of an Impactor handle for closing small valves tightly. The maker claims that the new Edward Impactor handle delivers 2.8 times the force of conventional handwheels. It is so designed that the lugs on the underside of the handle strike simultaneous blows against the lugs of an adaptor securely attached to the valve stem. It is available with two adaptors of different size square openings to fit most standard size stems of various small valve makes.

Circle letter (V) on reply card.

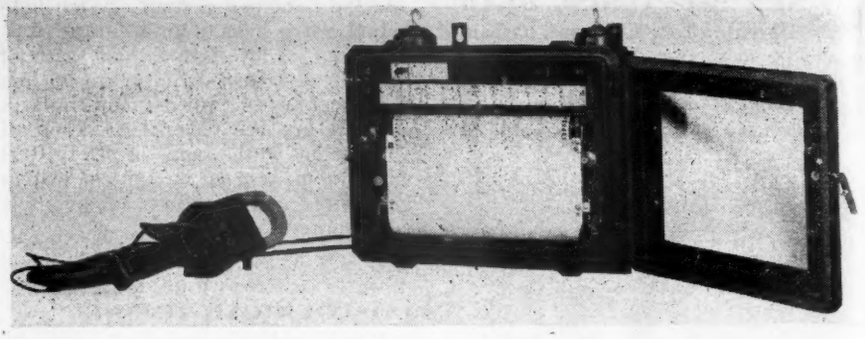
(W) TRIPLEX PUMP

A compact high pressure triplex pump has recently been introduced by Kobe, Inc., division of Dresser Equipment Company, as a heavy-duty packaged hydraulic power generator for



all types of hydraulic power systems. The unit is available in 15 hp, 30 hp, and 50 hp sizes with pressure ratings up to 5000 psi and displacement ratings up to 60 gpm. Special 10,000 psi and 20,000 psi heads are available. Features of the Kobe Triplex pump include integral gears, available in a wide variety of ratios. The unit can be obtained with an integral, drip-proof Sterling electric motor drive. Plungers and liners are interchangeable.

Circle letter (W) on reply card.



The new TAG recording ammeter

(X) RECORDING AMMETER

A new, trouble-shooting combination, the TAG recording ammeter used portably with a Weston Clamp-Ammeter Unit Model 633, Type AIR-A2R, is now available from the Tagliabue Instruments Division, Weston Electrical Instrument Corporation, for measuring and recording alternating current without breaking the circuit. Designed to check on and make a permanent record of the use of alternating current and circuit reactions, the new instrument can be employed to cover all operations within a power, manufacturing, or processing plant. The records obtained can reveal proper or improper handling of plant equipment, detect unwarranted use of power, and discover unnecessary waste time by checking the starting and ending time of operating equipment.

Circle letter (X) on reply card.

(Y) MOBILE RADIOS

New 25-50 mc mobile radio communications equipment for operation in both 20 KC and 40 KC channel widths, and featuring quadra-tuned IF transformers in the receivers, has been announced by the General Electric Company. Separate models are available for operation in either 20 or 40 KC channels, and the wide band equipment can later be converted to 20 KC operation. Using the 20 db quieting method, the reciever for 20 KC operation has selectivity of 100 db down at plus or minus 20 KC. By the same method, the 40 KC receiver has selectivity of 100 db down at plus or minus 30 KC.

Circle letter (Y) on reply card.

(Z) ANGLING BLADE BULLDOZERS

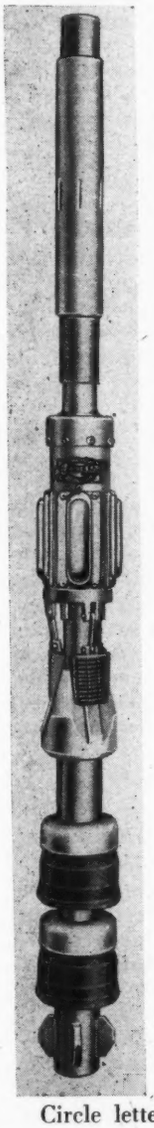
Preco Back-Rippers, which mount on the back of bulldozer moldboards and rip only when the tractor backs up, are now available for angling blade bulldozers, according to an announcement by Preco Incorporated. The four Back-Ripper housings are welded to the underside of the "C" frame on angling blade bulldozers, permitting their use irrespective of the angle of the blade itself. The teeth float on top of the ground when the tractor moves forward, and automatically dig and rip when the tractor backs up. Thus the dead-head back-up time enables the blade to make a full load on each forward trip.

Circle letter (Z) on reply card.

(AA) SYNCHRONOUS MOTORS

A new small synchronous motor with unusual operating characteristics has been announced by Allis-Chalmers Manufacturing Company. The motor, operating on the reluctance principle, has no brushes, slip rings, rotating coils, or permanent magnet. It can be built to operate continuously at any voltage below 250 volts, either single phase or polyphase. A typical motor is 4 in. in diameter by 2⅜ in. long, weighs 2.6 lb. and develops 8 oz-inch starting torque.

Circle letter (AA) on reply card.



(AB) PACKERS

A new hold down packer with an automatic latch, Type "AHD," is now in production at the Dallas, Texas, factory of the Guiberson Corporation. The new packer was designed for acidizing or injecting fluids into formations below the packer, and any other job where tubing pressure is greater than annulus pressure. According to Guiberson officials, Type "AHD" sets equally well at 1000 to 10,000 ft. An automatic latch is incorporated in the Type "AHD." The all-metal latching dog and corrosion-resistant springs plus the anti-lock mechanism assure the operator positive control of slips when setting or pulling. A telescoping valve that equalizes tubing and casing fluid assures easy running.

Workover operations using the Hydra-frac process showed the Type "AHD" holding pressures over 3000 psi and localizing the fluid until the treatment was completed. This story and picture were run in the October issue, with the photograph inadvertantly run up side down.

Circle letter (AB) on reply card.

Trade Literature

Publications will be sent free.

(AC) PLANT FACILITIES

A new, 4-page folder illustrating and describing the facilities of the plant at Compton, California, has been issued recently by Oil Base, Inc., manufacturers of Black Magic and conditioners for oil base drilling fluids. The products which the company manufactures and the company representatives in each area are also included. Pictures are used profusely throughout.

Circle letter (AC) on reply card.

(AD) VOLUME PUMPS

A new bulletin on Milton Roy motor-driven controlled volume pumps has been published recently by Milton Roy Company. This 24-page, 2-color, illustrated bulletin—Bulletin No. 251—will be of interest to anyone faced with the need of pumping practically any liquid, from heavy viscous liquids to light solvents, solids in suspension, abrasive slurries, hot or cold liquids, liquefied gases, and other materials. Bulletin No. 251 illustrates and describes standard Milton Roy motor-driven controlled volume pumps as well as models designed for special applications.

Circle letter (AD) on reply card.

(AE) SPECIFICATIONS

Using a unique system of visual cross reference charts, a new condensed catalog offered by the industrial truck division of Clark Equipment Company, Battle Creek, Michigan, makes all essential model and attachment information available at a glance. Broken down, page by page, the catalog shows specifications by model and capacity for both gas and electric fork-lifts with cushion-type tires and pneumatic tires. Similar treatment is given to Clark towing tractors and the new powered hand trucks, hand pallet trucks, hand platform trucks, and hand stackers.

Circle letter (AE) on reply card.

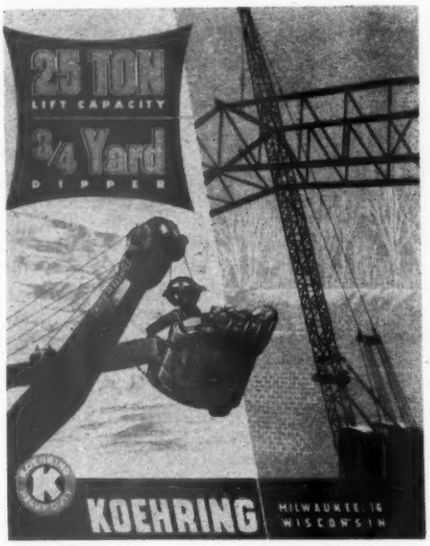
(AF) ALLOYS

A completely revised 20-page bulletin, PI-3, produced in two colors, giving complete information on Ampco alloys (aluminum bronze) as applied in corrosion-resistant service, has been released. This book includes corrosion-erosion-resistance and cavitation-pitting data along with physical and chemical properties of various aluminum bronze alloys recommended for such service. The metal working characteristics of Ampco Grade 8 sheet and plate are included as are the welding advantages of this alloy.

Circle letter (AF) on reply card.

(AG) EXCAVATOR ATTACHMENTS

Koehring Company recently prepared and made available for general distribution a new sales catalog describing the latest advancements made on the Koehring Model 304 excavator and its attachments. The attractive two-color



booklet contains 117 illustrations and drawings that depict the story of design, construction, work capacity, and wide application of the heavy-duty excavator. Officially rated as a ¾ yd excavator, the Model 304 combines a ¾ yd dipper with a 25-ton lift crane capacity on truck or cruiser mounting and a 13.9-ton capacity on crawlers. Numerous action photographs are employed in the new catalog along with a fine selection of machine part pictures. Included are detailed descriptions of such outstanding Koehring features as self-cleaning crawler shoes, skeleton type tapered drum lagging, automatic boom hoist brake, the mechanical booster clutch, and others.

Circle letter (AG) on reply card.

(AH) FABRICATING FACILITIES

An eight-page illustrated bulletin is offered by The Colonial Iron Works Company, to show their engineering and fabricating facilities for a wide variety of tanks, kettles, towers, reactors, and similar equipment. Photographs show numerous views of fabricating operations, machinery, and completed products. The bulletin describes facilities for shearing, forming, fitting, and welding to meet ASME and API-ASME codes. Colonial's inspection methods including the company's own radiography department are shown and described. Plant layout drawings show flow in of structural and plate parts and flow out of completed units.

Circle letter (AH) on reply card.

(AI) HYDRAULIC SYSTEM FILTERS

Complete engineering data on synclinal type filters for sump or line installation on all hydraulic and low pressure liquid recirculating systems is contained in folder recently published by the Marvel Engineering Company. Single unit capacity sizes available from 5 to 100 gal per minute. Filter mesh ranges from 30 to 200.

Circle letter (AI) on reply card.

(AJ) WELDING ACCESSORIES

A new 16-page, 8½ by 11 arc welding accessories catalog is announced by Hobart Brothers Company, containing the complete line of Hobart arc welding accessories and supplies. The catalog contains 16 pages of illustrated material. It includes such items as protective headshields, and clothing, goggles, visors, metallic and carbon electrode holders, cleaning tools, etc.

Circle letter (AJ) on reply card.

(AK) ALLOY RODS

Victor Equipment Company announces five new bulletins available covering their complete line of hard-facing alloy rods: Victor Tungsmooth, a fine mesh tungsten carbide rod for electric or acetylene application; Victortube, a tungsten carbide rod for electric or acetylene application, and Victoralloy, a fabricated rod containing alloys in a tube and coated with a high alloy coating, and designed for resistance to abrasion and ability to withstand severe impact.

Circle letter (AK) on reply card.

(AL) DRILLING RIG

A 16-page bulletin just released by The National Supply Company describes its Ideal Type 130 consolidated drilling rig incorporating a 1300-input-horsepower draw works, which has proved itself in today's deep and fast moving drilling operations. Incorporated in the rig are recent improvements and the time-proved features including centrally located air actuated controls; air operated clutches, brakes and cat-heads, and two-section construction for easy transportation.

Circle letter (AL) on reply card.

(AM) PRESSURE MEASURING

Application of the Baldwin SR-4 fluid pressure measuring system in oil and chemical processing for automatic control, remote indicating and recording, is featured in a new 4-page bulletin issued by Baldwin-Lima-Hamilton Corporation. The bulletin covers (1) the principles of the SR-4 bonded resistance wire strain gage and pressure cells, (2) electrical transmission of pressure variations with only 4 to 8 volts and currents of less than 0.07 ampere, (3) elimination of the fire and explosion hazard of oil or gas transmission to control panels, and (4) the permanency and accuracy of the pressure measurement system.

Circle letter (AM) on reply card.

(AN) PRODUCT DESIGN

A 16-page catalog prepared especially for product designers' use has just been published by Chicago Metal Hose Corporation. This catalog was prepared to give complete description and specifications of the many products manufactured by Chicago Metal Hose for original equipment manufacturers' use. Information on metallic bellows of stainless steel, brass, bronze, and other alloys is included. Complete specifications giving the pertinent characteristics of the complete size range of these bellows, which are used extensively in many types of control, regulators, and thermostatic devices, are given.

Circle letter (AN) on reply card.

(AO) STOCK BOOK

Publication of new price list and stock book, covering its complete line of nonferrous and stainless steel fastenings, is announced by The H. M. Harper Company. Containing 56 pages, the book is of convenient size and is printed in three colors with every type of fastening shown in natural color. An index page lists all fastenings by alloy and type for fast, easy reference. Included in the booklet are complete descriptions of all Harper everlasting fastenings carried in stock.

Circle letter (AO) on reply card.

(AP) SUB-SURFACE PUMPS

Harbison-Fischer Manufacturing Company has issued a new 34-page supplement to its general catalog of oil well sub-surface pumps and related production equipment. Included in the new section are cut-away illustrations and complete details of more than a dozen new pumps and other equipment added to the firm's line. The new pumps were especially designed for deep wells, stripper wells, and sandy fluid production.

Circle letter (AP) on reply card.

(AQ) TUBE FITTINGS

Swagelok tube fittings Catalog B-151 describes and illustrates the complete line of leakproof Swagelok tube fittings that are available in brass, aluminum, steel, stainless steel, and Monel. Complete dimensional information, cross section drawings, installation recommendations, and assembly instructions are also included. Crawford Fitting Company.

Circle letter (AQ) on reply card.

(AR) CHRONOFLO TELEMETER

Builders-Providence, Inc., has issued a new bulletin on Chronoflo Telemeters (Bulletin No. 230-H4). This eight-page bulletin describes the Chronoflo telemeter, which makes possible the transmission of information and controls over a simple two-wire electrical circuit for unlimited distances. The bulletin lists the many features of the device, describes the operation of the transmitter and receiver, and shows photographs and diagrams.

Circle letter (AR) on reply card.

(AS) WET-PIT PUMPS

A new bulletin W-317-B12, describing freeflo pumps for sump, sewage, and drainage service, has been announced by Worthington Pump and Machinery Corporation. The manufacturer describes its FLJ and FLJD wet-pit pumps as having non-clogging sewage pump impellers capable of passing solids and stringy material. Unlike most designs of wet-pit non-clogging pumps, these pumps have a stuffing box above the impeller and the pump bearings are above and separate from the box. As the stuffing box is normally inaccessible, it is equipped with U-cup packing, which requires no adjustment.

Circle letter (AS) on reply card.

(AT) ROTAMETERS

The complete line of Brooks rotameters is presented in Bulletin 110, just released by the Brooks Rotameter Company. Designed to meet every known purge meter requirement, Brooks rotameters range from the inexpensive Brooks-Mite for small flow indication of liquids or gases to high capacity; high pressure meters, and versatile research and test kit models for a wide range of industrial applications.

Circle letter (AT) on reply card.

(AU) FRACTIONATING TRAY

Koch Engineering Company has published a bulletin of the new "Benturi"-type Kaskade fractionating tray. This new bulletin gives valuable information on the outstanding performance of "Benturi"-type Kaskade tray in distillation, absorption, and liquid-liquid extraction.

Circle letter (AU) on reply card.

(AV) TUBES AND PLATES

A new and expanded edition of "Anaconda Tubes and Plates for Condensers and Heat Exchangers" has been announced. It was written especially for use by engineers responsible for the selection of materials in the marine, oil refining and stationary steam power plants. This 44-page booklet discusses the application and installation of condenser and heat exchanger tubes, also plates for tube sheets, heads and baffles. The American Brass Company.

Circle letter (AV) on reply card.

(AW) JET PUMPS

A new bulletin on the Penberthy jet pumps is now available to the public. The 20-page, 2-color bulletin is profusely illustrated with pictures, diagrams, and a number of charts. Various tables give capacities for different size ejectors, pumping water under various conditions of operating steam pressure, suction lift, suction water temperature, and discharge head. The jet pump is a device that is able to induce fluids, vapor, or gases into the suction chamber and discharge the mixture against pressure.

Circle letter (AW) on reply card.

(AX) VALVES

A new bulletin on valves for boiler services, such as surface blow, bottom blow-off, water column blow-off, and connections, has been published by Everlasting Valve Company. The bulletin describes the Everlasting quick-opening and slow-opening Straightway valves, Angle valves, "Y" valves, and Duplex Blow-Off units, with complete specifications of construction and dimensions of each type.

Circle letter (AX) on reply card.

(AY) MUD TESTING

The Geophysical Machine Works has just published a new catalog describing in detail its entire line of mud testing equipment. This new catalog illustrates and gives all specifications of the Fann mud balances and V-G (viscosi-meter) meter and accessories; Fann portable and multiple filter presses; small size pressure adapters for older types of filter presses, and mud mixers.

Circle letter (AY) on reply card.

(AZ) EQUIPMENT CATALOG

A new catalog on Aircomatic equipment and wires has been announced by Air Reduction Magnolia Company, a division of Air Reduction Company. This colorful, illustrated catalog describes the Aircomatic gun for manual operation, the Aircomatic head for automatic operation and the Aircomatic wires for use with either manual or automatic equipment. Photographs and sketches of the equipment are supplemented by on-the-job illustrations of some applications of the product.

Circle letter (AZ) on reply card.

(BA) PIPE CORROSION

Tennessee Eastman Company announces the publication of a new book, *The Use Of Tenite To Combat Corrosion In Piping Systems*, fully illustrated story of noncorrodible butyrate plastic pipe in the oil fields. The brief text discusses the corrosion problem faced by an oil lease layout, and the characteristics of Tenite tubing — noncorrodibility, high impact strength, ease of installation, etc. Twenty-six photographs taken in the oil fields show how Tenite pipe is installed and used.

Circle letter (BA) on reply card.

(BB) PARTS CATALOG

Milo Radio and Electronics Corporation has announced the publication of its new 1100 page 1952 general catalog. This large, handsome, hard-cover bound book contains a listing of over 75,000 items and 7000 illustrations of the major standard brand radio-electronics products in the industry, complete with technical specifications, physical dimensions, and prices. Devoted specifically to the industrial field, Milo Radio features and carries in stock items that are widely used in every conceivable industry—for production, research, development, processing and control, etc.

Circle letter (BB) on reply card.

(BC) "MICRO-FEEDER"

A 4-page bulletin entitled "Micro Feeder" is available from %Proportioneers, Inc.%. The Micro Feeder consists of a measuring cylinder assembly mounted horizontally in a cast iron frame and secured to a steel baseplate. The feed screw is driven by a standard fractional horsepower synchronous motor coupled to the variable speed transmission. An operating switch, limit switch, and indicating light are mounted on the frame holding the cylinder. Four figures give a complete and concise description of the feeder and its various parts.

Circle letter (BC) on reply card.

(BD) ELECTRODES

A new brochure aimed at acquainting those individuals with the electrodes used during World War II and to refresh the memories of others with past experience is available to the public from Alloy Rods Company. Text of the bulletin is a description of the alloy electrodes most widely used in the defense program. Many other analyses of electrodes manufactured by the Alloy Rods Company are being used elsewhere in the defense effort, but their uses are highly specialized and limited. The booklet contains various types of welding electrodes.

Circle letter (BD) on reply card.

(BE) OIL FIELD JACKS

A complete line of lifting and lowering jacks for service in oil fields and refineries is illustrated and described in a new four-page bulletin published by The Duff-Norton Manufacturing Company. Featured is the No. 1523 all-purpose oil field jack, which is applicable for four types of jacking: (1) straight lifting; (2) chain lifting, (3) claw lifting and (4) foot lifting. In addition, dimensions, capacities, and other significant data are included for seven other types of jacks in 33 different sizes.

Circle letter (BE) on reply card.

(BF) AERIAL SURVEYS

Abrams Aerial Survey Corporation has published a 2-color 16-page booklet discussing aerial surveys and maps from photographs. It presents a brief-nontechnical explanation of aerial photogrammetry. Various products are shown that are made from aerial photographs and suggestions offered for saving time and money on engineering projects through aerial mapping. Photogrammetry is the science of making measurements from photographs. One of its most important applications is to aerial photographs, for with photogrammetry maps can be made and surveys engineered from the air. On the first 2 pages of the booklet the photogrammetric process is diagrammed. The following pages illustrate the planes and cameras used and instruments used in the laboratory processing.

Circle letter (BF) on reply card.

(BG) THERMOCOUPLE SUPPLIES

A 40-page catalog supplying much useful technical data on the application and use of thermocouple pyrometric supplies has been published by Minneapolis-Honeywell Regulator Company. The catalog includes a complete line together with basic prices of all Brown standard thermocouple assemblies including base metal elements and Noble metal elements gages. Ordering procedures for various complete assemblies as well as the extension wire, terminal heads, blocks, and many other items is explained. Enlarged view of all assemblies plus special molten meat, metal, pencil type, and midget thermocouples are included.

Circle letter (BG) on reply card.

(BH) FIRE PROTECTION

What one should know about modern fire-fighting devices and the different fire extinguishing agents used in them, is contained in a new 32-page illustrated booklet titled "Correct Fire Protection." It is published by the American-La-France-Foamite Corporation. As it is universally known that all fires are not alike, it is essential that operators of fire extinguishing equipment know the correct fire extinguisher for use on the kind of fire to be extinguished. This new educational booklet not only makes this important information clear, but it also illustrates and describes the various sizes of units available for use with the different kinds of fire extinguishing agents.

Circle letter (BH) on reply card.

(BI) MUD THINNER

A new 8-page bulletin titled "Maccotan Improved Mud Thinner" has just recently been published. It describes specially compounded chemical thinner for clay-water muds or clay-water-oil emulsion muds specifically formulated to replace allocated quebracho with increased efficiency. It gives characteristics, effect of alkalinity, effects of cumulative contamination, comparison of viscosity characteristics, with supporting comprehensive charts, and detailed information on use and maintenance of the thinner. Macco Corporation.

Circle letter (BI) on reply card.

(BJ) PHOSPHATE TREATMENT

A new 8-page booklet describing Anchorite 100, a paint-anchoring corrosion-resistant phosphate treatment for metals, has just been published by Octagon Process, Inc. Attractively printed in two colors, the booklet describes in detail the common causes of paint failure and how they can be prevented. It then goes into methods of application—immersion and spraying—of the Anchorite 100 treatment. A separate discussion of typical products to which the Anchorite 100 process can be applied is well illustrated, and includes a number of defense items.

Circle letter (BJ) on reply card.

(BK) PLUG VALVES

American Car and Foundry Company has a new bulletin out on lubricated plug valves. The cylindrical plug of the ACF lubricated plug valve gives a well-proportioned, round-cornered, full pipe-area port opening. Unrestricted flow and full pressure of fluids through pipe lines is of paramount importance in chemical and processing plants. The ACF lubricated plug valves do not require auxiliary packing at the stem, being thoroughly sealed by a resilient, replaceable lubricant gasket.

Circle letter (BK) on reply card.

(BL) PLASTIC PRODUCTS

The American Agile Corporation has published a 2-color, 4-page booklet outlining the plastic products which it manufactures. Besides the portrayal and description of actual products, the Agilene process and the properties of Agilene is explained in such a manner that the reader can apply his on specific problems in this field. Agilene designates the various grades of Polyethylene used in the products and fabrications manufactured by American Agile.

Circle letter (BL) on reply card.

(BM) ENCLOSED MOTORS

Construction details of Allis-Chalmers totally-enclosed, fan-cooled motor (Type APZ) are described in a new bulletin released by the company. Due to the elimination of internal air passages and dirt-catching pockets, the motor is easy to keep clean. This feature, together with an efficient cooling system, makes the motor suitable for use where there is dust, dirt, fly ash, rain, snow, or corrosive gases. Construction features of the motor, which can be mounted anywhere, include a rigid cast iron frame that resists corrosion and holds bearings permanently in alignment, double insulated stator, improved heat dispersal, die cast rotor, rotating seals on both ends of motor, double-shielded bearings, ribbed end shields, and roomy conduit box.

Circle Letter (BM) on reply card.

(BN) TWO-WAY RADIO STATION

A new and compact console-type two-way radio station, designed for fixed-station use in any two-way radio communications system operating in the 30-50-mc frequency range, has just been announced by the communications section of the RCA engineering products department. This new desk-type Fleetfone station (Model CSF-60A) combines a 60-watt transmitter-receiver and its power supply in one attractively styled case. Provisions for remote control, optional two- or three-channel transmitter operation, dual-channel receiver operation, and use of local or remote-type speakers give this station unusual versatility for such important services as trucking and petroleum industry communications.

Circle letter (BN) on reply card.

BOOKS

The Big Play, *by Elinor Pryor. Published by McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 18. Price, $3.75. Pages, 454.*

"The Big Play" is a novel about the oil industry, written by one who grew up with that industry. The story of Brock Catlin, who made his money by the "big play", till he worked his way up from an uneducated tool dresser on an oil well in Texas to an independent oil operator worth millions. The story of his personal life is laid against the background of the struggle for oil in the Southwest.

POSITIVE OIL SHOW IDENTIFICATION with MINERALIGHT Ultra-Violet
(BLACK LIGHT)

Make sure you don't pass up possible pay! Make positive core identification checks with new model MINERALIGHT SL long wave ultra-violet lamp.

Proved best by test for oil show analysis!

No experience needed to operate. Lamp weighs only 1 lb. Models available for 110 volt AC or with adapter, 110 volt DC current. Battery operated model for field use holds lamp, has built-in viewer for daylight examination. Easily portable.

FREE

Send for illustrated brochure on how to detect and analyze petroleum in oil surface samples with ultra-violet.

ULTRA-VIOLET PRODUCTS, INC.
Dept. PE, 145 Pasadena Ave., South Pasadena, Calif.

"Cuts cleaning time from 10 days to 12 hours"

That's what one operator says about the Oakite Interior Tank Cleaning Unit. And that's not all . . . this versatile unit cuts costs from $2000 to $450 . . . cuts clean-up crew from 10 men to 4. Rotating nozzles of this powerful Oakite Tank Cleaning Unit discharge hot Oakite detergent solution at 100 lbs. pressure; blast every square inch of surface clean. No more hand-brushing, scraping, steaming-out.

Try Oakite cleaning on your tank cars, ship tankers, barges. Write Oakite Products, Inc., 48 Thames St., New York 6, N. Y., for illustrated circular. FREE!

SPECIALIZED INDUSTRIAL CLEANING
OAKITE
MATERIALS • METHODS • SERVICE
Technical Service Representatives Located in Principal Cities of United States and Canada

Corduroy Road, *The Story of Glenn McCarthy, by Wallace Davis. Published by the Anson Jones Press, Houston, Texas. Price, $5. Pages, 282*

The life of a controversial personality who is a contemporary is always a hard one to write, but the author has solved many of his problems by collecting the opinions of those who know McCarthy, his friends, enemies, family, and employees. The book is made up of anecdotes of McCarthy's life, picturing him as: a business man; pump monkey, shoestringer, designer, boy driller, sheriff dodger, gambler, and town-builder, as some of the titles portray him.

One of the stories, as told by the oil man who interviewed him, concerns the day McCarthy came into the office of his company looking for a drilling contract. Asked where his rig was, McCarthy said he didn't have a rig, but he could get one. When asked where his crew was, he answered that he didn't have any crew, but he knew where he could get some men. To the question of experience, McCarthy said he didn't have any experience, but the men he could get had the experience; he just knew that he could drill a well if he could get a contract. Later, McCarthy drilled some wells for this same company at 50 cents cheaper a foot than the company itself was drilling, and made a profit. Pushing through a series of ups and downs, and existing on sheer gamble has typified McCarthy's oil career. At one time, on the advice of Mike Halbouty, his geologist, he drilled a rank wildcat on a 100-acre tract of land, with 11 days to set up the rig before the lease expiration date. The result was the discovery of the West Beaumont field.

The author, Wallace Davis, is well-known in the oil industry —was for many years a writer for oil publications, and for the past two decades has operated a prominent industrial advertising agency on the Gulf Coast. The book will be available at leading book stores.

Herbert H. Dow, Pioneer in Creative Chemistry, *by Murray Campbell and Harrison Hatton. Published by Appleton-Century Crofts, Inc., 35 West 32nd Street, New York 1, N. Y. Pages, 168. Price, $3.50.*

This book is an account in non-technical terms, of one man's share in the founding of a company. When Herbert Dow built his first little chemical plant, all but a few easy-to-make chemicals came from Europe. When he died 40 years later, his company alone was making 800 carloads a month of 150 different chemicals. Working with borrowed money and home-made equipment of his own devising, Herbert Dow first manufactured bromides, later adding bleach to his line. Eventually phenol, magnesium, and synthetic indigo were only a few of the spectacular products that made Dow one of the great men in American chemical industry.

Oil and Gas Fields of the Texas Lower Gulf Coast, *by Dr. Frank J. Gardner. Published by Petroleum News Corporation, Box 331, Houston, Texas. Price, Subscribers, $25. Non-subscribers, $50. Pages, 234.*

The first area book in a series of 12 volumes designed to cover the entire state of Texas, New Mexico, and Coastal Louisiana, contains a summary of development on 350 oil and gas fields. These reference reports have been published along the same line as the Railroad Commission's set-up of districts. The ten counties covered by this volume have accounted for some of the most prolific oil fields in the Southwest. Each county is separated by a page bearing a survey map of that county with all fields located upon it in detail. An index of field and county names is to be found in the back of the book.

The Seamless Story, *by J. Perc Boore. Published by The Commonwealth Press, Inc., 1507 DeLong Street, Los Angeles 15, California. Price, $5.75. Pages, 285.*

The complete story of seamless steel tubing is given in this book, from the history of its invention, the story of its inventors, the development of the product, biographies of personalities which were and still are in the seamless tubing industry, to the outline and development of contemporary mills. Especially interesting is the extensive bibliography, which covers book and magazine articles, as well as giving a list of British and American patents. The book is not a technical one, but purely historical, arranged in chronological order, with stories of the various mills told separately.

Have you talked to your Lane-Wells Man lately about

Engineered PACKER SERVICE

The 8 Points of LANE-WELLS ENGINEERED PACKER SERVICE

1 DO I NEED A PACKER?

Analysis of well conditions often reveals that a packer, though applicable, would be less desirable than some other piece of equipment. Lane-Wells men recommend the tool best suited to your needs.

2 WHAT CAN PACKERS DO FOR ME?

Operators are sometimes surprised to find how wide a variety of oil field operations packers perform. Lane-Wells men can work out with you packer settings for a range of down-the-hole jobs.

3 WHICH PACKER IS RIGHT FOR THIS JOB?

Most operators are aware that different types of packers can be used — but only one is really right for the job. Your Lane-Wells field man can help you select that one right packer.

4 HOW TO SET THIS PACKER?

There are at least 15 different factors which must be taken into account to assure a proper packer setting. Lane-Wells field men lay out packer settings on which you can rely.

5 HOW ABOUT PULLING A PACKER?

Pulling a packer involves as many factors as setting. Your Lane-Wells packer expert plans procedures which pull packers efficiently.

6 HOW TO GET THE MOST FROM A PACKER.

Your Lane-Wells man can review your packer programs, tell you how to evaluate their efficiency, and show you what to expect from a packer.

7 IS THIS PACKER STILL GOOD?

Many used packers have been saved for further service by Lane-Wells field men, who can advise on proper maintenance and on both field and shop repair and reconditioning.

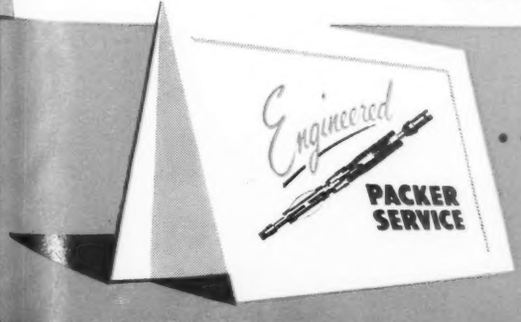
8 IMPROVED EQUIPMENT.

We thought this went without saying, but after the favorable comments on SLYDEZE Slips and the new BOCI packer, we include it to remind you that Point 8 is always present.

Tomorrow's Tools-Today!

If you haven't, he's got some interesting things to tell you. Because now, after a little more than a year since Engineered Packer Service was announced, your Lane-Wells man has a lot of convincing evidence that it pays off for operators who use it. He can recite chapter, book and verse, give you actual case histories, that prove the value of this free service on any packer problems you might have.

ASK YOUR LANE-WELLS MAN!



...by...

LANE WELLS

TECHNICAL OILFIELD SERVICES

General Offices, Export Office and Plant • 5610 So. Soto St. Los Angeles 58, California

Los Angeles • Houston • Oklahoma City
Lane-Wells Canadian Co. In Canada
Petro-Tech Service Co. In Venezuela

FIELD TESTED

REMARKABLE RECORD FOR SAVING RIGTIME

A long list of triumphant field trials has earned top honors in the oil world for Halliburton's Retrievable Cementer.

It can be run in rapidly on tubing or drill pipe, set and used for a series of squeeze jobs, then immediately removed!

A remarkable saving in rigtime results, and wells are producing sooner by hours.

Your Halliburton representative will be happy to give you a detailed report.

"THERE'S NO SUBSTITUTE FOR EXPERIENCE IN OIL WELL CEMENTING"

NO METAL TO DRILL

- LOCATE PERFORATIONS
- PUMP CEMENT, ACID OR PLASTICS
- PLACE CEMENT AROUND CASING SHOE
- CEMENT IN OPEN HOLE
- RUN MULTIPLE CEMENT JOBS
- FIND AND REPAIR LEAKS

HALLIBURTON

RETRIEVABLE CEMENTER

HALLIBURTON OIL WELL CEMENTING CO.

DUNCAN, OKLAHOMA